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2010-2011

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VOLUME 142 *2011*

I am honored to be the new Editor of JESO. It is a privilege to serve the Entomological Society of Ontario and its venerable scientific Journal in this way. I sincerely thank the previous Editor, Miriam Richards, for her good work over the past six years, in particular overseeing the transformation to electronic publishing. Since 2005 authors have received a free pdf version of their paper for electronic distribution, which I hope has increased the visibility of their work to their satisfaction.

I have greatly depended upon the Associate Editors Andy Bennett, Neil Carter, Jeff Skevington, and the unofficial help of Cynthia Scott-Dupree and Kevin Barber. They found knowledgeable reviewers and sometimes reviewed manuscripts themselves. Their comments to the Editor were summarized in critical and constructive ways that made my work easier and improved the quality of manuscripts. Jess Vickruck, the new technical editor, has quickly and efficiently provided proofs and made changes as needed. Grateful thanks are extended to all of them for their excellent work and advice.

Beginning next year page charges will be dropped in the hope that this will increase the number of manuscripts submitted. In 2012, pdfs will be posted as soon as proofs are finalized, as was done over the past few years, except for 2011 (this volume) while I was familiarizing myself with the editorial process.

Ontario occupies about one million square kilometers of land and fresh water (10% of Canada). The province extends 1730 km north-south and 1680 km east-west, from the southernmost point in Canada (40°41'N, the latitude of Rome, Italy) to the Manitoba border at Hudson Bay (56°50'N, the latitude of London, UK). Its several ecozones, from the Hudson Bay lowlands to remnants of prairie and Carolinian forest, contain a multitude of terrestrial and freshwater habitats. Agriculture covers much of southern Ontario and about includes about 100 types of crop, from greenhouse plants to fruit trees. Given this natural and artificial diversity, there is endless opportunity for entomologists to research and publish on Ontario insects. JESO is an admirable vehicle for these publications, emphasizing but by no means restricted to the Ontario fauna. Plenty of alien species have also unwittingly or deliberately been introduced into the province or have arrived on their own, and they keep coming. Several of the articles in this Volume treat alien species recently found in Ontario or likely soon to establish residence here. Alien insects, wanted or not, arriving in Ontario present yet another opportunity and reason to publish in JESO.

John T. Huber
Editor

EFFECT OF HARVEST ON EUPHORINE (HYMENOPTERA: BRACONIDAE) PARASITISM OF *LYGUS LINEOLARIS* AND *ADELPHOCORIS LINEOLATUS* (HEMIPTERA: MIRIDAE) IN ALFALFA

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Abstract

J. ent. Soc. Ont. 142: 3–10

Effective biological control of *Lygus lineolaris* and *Adelphocoris lineolatus* depends on the availability of appropriate host stages to sustain populations of euphorine parasitoids which are important in reducing pest populations. In Quebec alfalfa, crops are cut 2–4 times during the summer season, yet how this affects the host and parasitoid populations is poorly understood. A 3-year study conducted from 2000–2002 in southern Quebec demonstrated that overall, abundance of susceptible host stages (N2+N3) in cut alfalfa were less than half of those collected in uncut alfalfa, even after 4–5 weeks when the cut crop reached the same height as the uncut crop. Parasitism levels of N4+N5 nymphs in the cut crop were usually less than those in the uncut crop, although on several sampling dates the reverse was observed. Numbers of adult *L. lineolaris* and *A. lineolatus* were always lower immediately after harvest in the cut crop but numbers increased in the following weeks to equal those collected in the uncut crop. These results suggest that periodic harvest of alfalfa reduces available host stages for parasitism and subsequent levels of parasitism but does not cause elimination of parasitoid populations. Furthermore, dispersing adults likely contributed to an increase in abundance of susceptible host stages after habitat modification, thereby sustaining parasitoid populations.

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Introduction

Effective biological control of *Lygus lineolaris* (Palisot) and *Adelphocoris lineolatus* (Goeze) (Hemiptera: Miridae) depends on the availability of appropriate

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host stages to sustain populations of euphorine parasitoids such as native species of the *Peristenus mellipes* complex and the introduced *Peristenus digoneutis* Loan (Hymenoptera: Braconidae) (Day 2005). Alfalfa, *Medicago sativa* L. (Fabaceae), is an important reservoir for *Lygus* spp. and its euphorine parasitoids (Mueller et al. 2005; Seymour et al. 2005; Pickett et al. 2009), and management of alfalfa, as a main crop or as a trap crop, influences pest numbers in adjacent crops such as cotton and strawberries (Godfrey and Leigh 1994; Pansa and Tavella 2009; Pickett et al. 2007, 2009). In alfalfa, crops are typically cut 2–4 times during the summer season. Although cutting may or may not result in mass migration of *Lygus* to adjacent crops (Poston and Pedigo 1975; Stolz and McNeal 1982; Cárcamo et al. 2003; Demirel and Cranshaw 2006), how cutting affects the natural enemy populations is poorly understood. The effects of cutting alfalfa on host and predator populations have been studied (Rakickas and Watson 1974; Schaber et al. 1990; Godfrey and Leigh 1994) but no study was found that documents the effects of cutting on parasitoid populations. This study compared populations of *L. lineolaris* and *A. lineolatus* in cut and uncut alfalfa to determine the effect of harvest on the availability of susceptible host stages for parasitism and levels of parasitism in a managed crop system.

Materials and Methods

A 3-year study was conducted from 2000–2002 in southern Quebec at the Agriculture and Agri-Food Canada Research Farm near Sainte-Clotilde-de-Châteauguay (45.15°N 73.67°W). In each year, weekly samples consisting of 200 180°-arc sweeps were taken from a 2-ha field beginning in early May (2001 and 2002) or mid June (2000) until first frost in late September. At first harvest, the first or second week of June, half of the field was cut and the other half was left as uncut. Samples were taken from cut and uncut parts until the next harvest at which time the previously uncut portion was cut and the treatments reversed. Each half of the field was cut twice during the season. Each sample was aspirated into plastic vials using a Hausherr's Machine Works® power aspirator, labeled, and placed in a cooler. In the laboratory, for each sample, species and nymphal instars (N1–N5) were documented and parasitism levels determined by dissecting individuals of each instar. Due to manpower limitations, rearing of sub-samples of parasitized hosts were not done, however, a parallel study (Goulet and Mason 2006) conducted during the same years provided information on the euphorine parasitoid species present.

Analysis of variance using PROC GLM and LSD means comparisons were performed using the SAS statistical package (SAS 2008). Comparisons were made within each year and among years of mean weekly counts and mean parasitism of *L. lineolaris* and *A. lineolatus* populations in cut and uncut portions of the field. Data were normalized by using the log (x+1) transformation for plant bug counts and the square root of percent parasitism values.

Results and Discussion

For *L. lineolaris*, mean numbers per week did not differ between cut and uncut alfalfa in 2000, although values in cut alfalfa were lower, but did differ in 2001 and 2002

TABLE 1. Mean number per week (±SE) of N2+N3, N4+N5, and adult *Lygus lineolaris* and *Adelphocoris lineolatus*, and mean % parasitism (±SE) of N4+N5 in cut and uncut alfalfa near Sainte-Clotilde-de-Châteauguay, QC in 2000, 2001, and 2002.

	2000		2001		2002	
	uncut	cut	uncut	cut	uncut	cut
Lygus lineolaris						
N2+N3	27.4 (11.0)	3.6 (1.4)	51.1 (24.7)	4.5 (3.2)	20.5 (6.6)	1.4 (0.8)
N4+N5	48.4 (11.6)	22.9 (6.1)	91.3 (36.7)	23.7 (13.5)	87.1 (36.3)	9.8 (3.3)
Adult	72.7 (24.5)	29.6 (8.7)	83.9 (19.0)	34.7 (17.1)	49.4 (16.0)	22.8 (8.3)
% parasitism of N4+N5	22.7 (5.7)	15.5 (5.7)	22.5 (5.2)	20.2 (9.1)	22.4 (8.4)	29.3 (19.2)
Adelphocoris lineolatus						
N2+N3	4.4 (1.9)	1.7 (1.1)	2.0 (0.9)	0.8 (0.4)	7.2 (1.9)	4.3 (2.5)
N4+N5	8.6 (3.2)	17.9 (11.2)	16.2 (5.4)	13.7 (7.7)	21.2 (7.8)	16.1 (7.7)
Adult	11.9 (3.6)	5.1 (2.4)	33.1 (8.4)	11.5 (5.5)	28.4 (9.1)	9.6 (3.8)
% parasitism of N4+N5	3.6 (2.3)	1.7 (1.4)	10.5 (6.6)	1.2 (0.8)	6.9 (2.0)	10.5 (9.0)

(Table 1). In both 2001 and 2002 significantly more N2+N3 (2001—$F_{(1,28)}$=5.88, P=0.0223; 2002—$F_{(1,34)}$=12.16, P=0.0014) and adults (2001—$F_{(1,28)}$=8.54, P=0.0069; 2002—$F_{(1,34)}$=4.50, P=0.0415) occurred in the uncut alfalfa compared to the cut alfalfa. Overall, mean numbers of N2+N3, N4+N5, and adults did not differ significantly among years in the uncut and cut alfalfa, except numbers of N4+N5 were significantly higher ($F_{(2,41)}$=3.51, P=0.0396) in the cut alfalfa in 2000 compared to 2002 (Table 1). There were no significant differences (P>0.05) in parasitism (N4+N5) of *L. lineolaris* between cut and uncut alfalfa in each year and among years for either cut or uncut alfalfa (Table 1).

For A. *lineolatus*, mean numbers per week did not differ significantly between cut and uncut alfalfa in 2000 but did differ in 2001 and 2002 (Table 1). In 2001 mean numbers of adults were significantly higher in the cut alfalfa compared to the uncut alfalfa ($F_{(1,37)}$=5.85, P=0.0207) and in 2002 numbers of N2+N3 were significantly higher in the uncut than cut alfalfa ($F_{(1,28)}$=5.88, P=0.0223). Mean numbers of nymphs and adults were not significantly different among years, except N2+N3 numbers which were significantly lower in the uncut alfalfa ($F_{(2,51)}$=4.69, P=0.0136) in 2001 compared to 2002 (Table 1). There were no significant differences (P>0.05) in parasitism of N4+N5 between cut and uncut alfalfa in each year and among years for either cut or uncut alfalfa (Table 1).

In all three years, for both *L. lineolaris* and *A. lineolatus*, numbers of susceptible host stages (N2+N3) collected weekly in cut alfalfa were less than half of those collected in uncut alfalfa, even after 4–5 weeks when the cut crop reached the same height as the uncut crop (Figures 1 and 2). This was anticipated since cutting destroys eggs and reduces the food source for nymphs, many of which die, and adults, which migrate out of the crop (Lim and Stewart 1976) leading to time delays as adults re-colonize and rebuild these cohorts. Numbers of adults were always lower immediately after harvest in the cut crop but numbers increased in the following weeks, in some cases to levels similar to (e.g., for *L. lineolaris*, weeks 10 and 19 in 2000, week 11 in 2001 and week 19 in 2002; for *A. lineolatus*, week 19 in 2000, and week 11 in 2001) or higher (e.g., for *L. lineolaris*, week 15 in 2000, week 15 in 2001, and week 14 in 2002; for *A. lineolatus*, week 10 in 2000, week 15 in 2001, and week 14 in 2002) than those in the uncut crop (Figures 1 and 2). Several studies have shown that

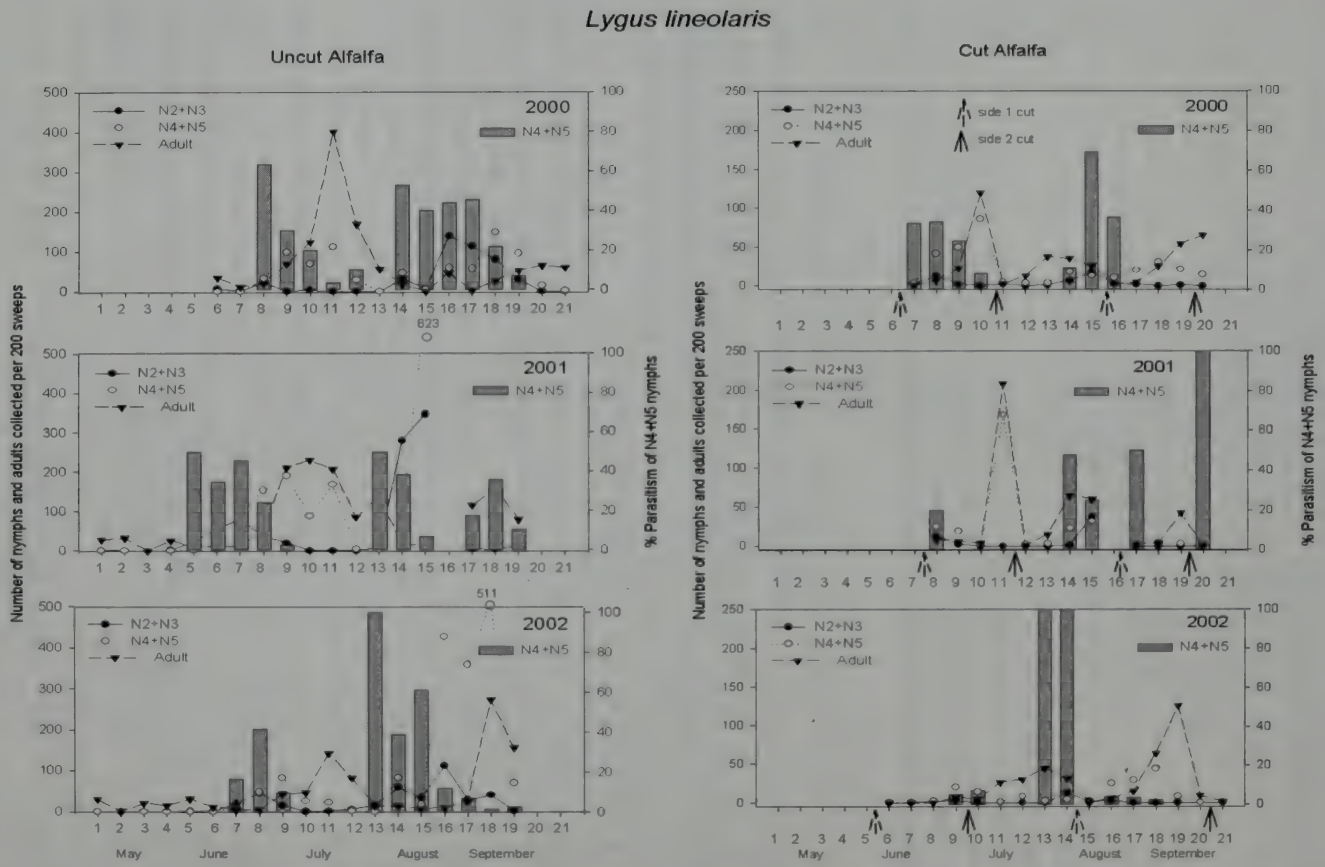

FIGURE 1. Number of *Lygus lineolaris* (Palisot) nymphs (N2+N3 and N4+N5) and adults collected (lines) and parasitism (%) of N4+N5 nymphs in uncut and cut alfalfa (bars) in 2000–2002.

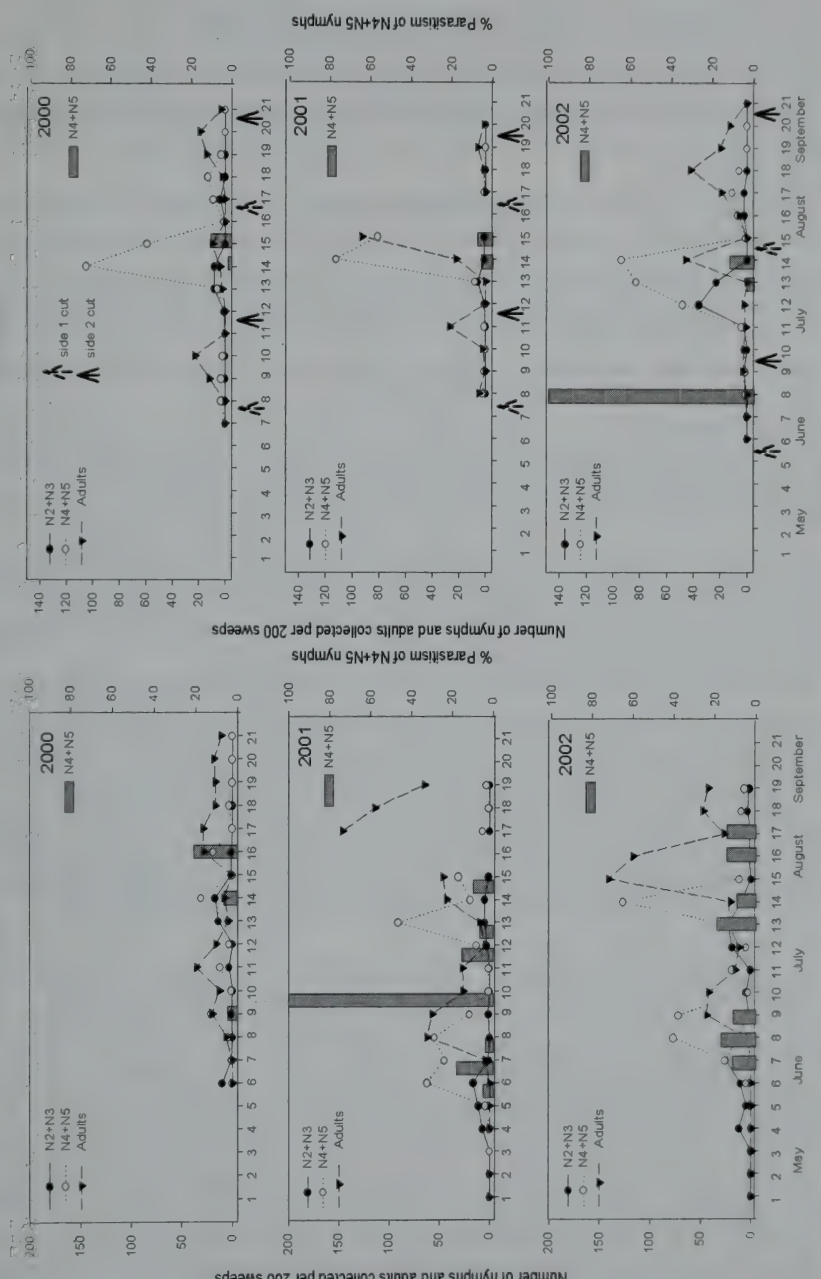

FIGURE 2. Number of *Adelphocoris lineolatus* (Goeze) nymphs (N2+N3 and N4+N5) and adults collected (lines) and parasitism (%) of N4+N5 nymphs in uncut and cut alfalfa (bars) in 2000–2002.

alfalfa is more attractive to pest species (*L. hesperus* Knight, *L. lineolaris*, *L. rugulipennis* Poppius) than are other crops and wildflower species in and around agro-ecosystems (Jackson 2003; Demirel et al. 2005; Mueller et al. 2005; Demirel and Cranshaw 2006; Pansa and Tavella 2009), so immigration from surrounding areas is expected. In contrast, parasitism of *L. lineolaris* in traditionally managed alfalfa was lower than in weedy habitat (Lim and Stewart 1976). Thus, nearby weedy habitats may serve as refuges for parasitoids and generalist species such as *L. lineolaris*, from which plant bug and parasitoid individuals re-invade the alfalfa crop.

Although Day (2007) argued that the most accurate measure of parasitism is achieved by assessing the N4 stage (earlier stages can still be attacked and parasitoid larvae egress from the N5 stage), we assessed the N4+N5 cohort because we concluded this better represented parasitism levels in our study. We consistently found parasitoid larvae in N5 hosts and believe that N5 hosts from which parasitoids had egressed would still be alive and show evidence of parasitoids (holes) allowing us to determine that they had been parasitized. In our study, parasitism levels of N4+N5 nymphs in the cut crop were usually less than in the uncut crop, although on a very few sampling dates the reverse was observed (Figures 1 and 2). Collection of parasitized N4+N5 nymphs in the cut crop suggests that harvest does not eliminate all individuals and more of this cohort survives than of the younger cohort (N2+N3). This may be due to the larger size of the N4+N5 individuals or behavioural changes induced by the parasitoids. In other systems it has been shown that parasitized hosts move down the plant to avoid hyperparasitism or to seek pupation sites (see Brodeur and McNeil 1989, 1992; Pivnick 1993). Whatever the mechanism, the occurrence of parasitized nymphs in the cut alfalfa provides for a continuum of parasitoids.

Our results are similar to the findings for plant bug predators. Godfrey and Leigh (1994) looked at the effects of cutting on populations of the predators *Orius tristicolor* (White), *Geocoris pallens* Stål, *G. punctipes* (Say), *Nabis alternatus* Parshley and *N. americoferus* (Carayon) (Hemiptera: Miridae) and found that all of these highly mobile species persisted in significantly higher numbers, as did those of the pest *L. hesperus*, in alfalfa strip-cut every 28 days compared to alfalfa entirely cut every 28 days. The significantly higher numbers of *L. hesperus* in the strip-cut alfalfa compared to the entire-cut crop suggests that strip-cut alfalfa will retain pest individuals whereas complete cutting will result in adult migration to other crops.

The importance of parasitism, particularly by *P. digoneutis*, in reducing pest populations of *L. lineolaris* has been documented by Day (2005). Goulet and Mason (2006) reported six euphorine parasitoids associated with *L. lineolaris* and *A. lineolatus* from the study area. Among those associated with *L. lineolaris* are the introduced bivoltine *P. digoneutis*, the native univoltine *P. mellipes* (Cresson) and *P. pseudopallipes* Loan, and the native bivoltine *Leiophron lygivorus* (Loan). Two species, *P. dayi* Goulet and *P. rubricollis* (Thomson), both of which are univoltine, are rarely associated with *L. lineolaris*, their main host being *A. lineolatus*. The proportion of *P. digoneutis* relative to *L. lygivorus*, *P. mellipes*, *P. pseudopallipes*, and *P. dayi* increased from <1% in 1998 to 62% in 2002 (Goulet and Mason 2006). Thus, management strategies that conserve hosts for parasitism will facilitate regulation of pest species populations and spread of biological control agents such as *P. digoneutis*, first released in northern New Jersey (Day et al. 1990) and now established in southern Quebec (Broadbent et al. 1999) and still dispersing.

Conclusions

These results suggest that periodic cutting of alfalfa reduces available host stages for parasitism and reduces levels of parasitism but does not eliminate parasitoid populations. Furthermore, dispersing adults likely speed up the increase in abundance of susceptible host stages after habitat modification, thereby sustaining parasitoid populations.

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NEW RECORDS OF EUROPEAN WIREWORM PESTS AND OTHER CLICK BEETLES (COLEOPTERA: ELATERIDAE) IN CANADA AND USA

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Abstract

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The predatory wireworm *Hemicrepidius niger* (L.) is newly reported from North America (Canada: Ontario and New Brunswick). The agricultural pest species *Athous haemorrhoidalis* (Fabricius) is newly recorded from North America (Canada: Ontario and USA: Massachusetts). New provincial and state records are reported for the Palaearctic agricultural pest species *Agriotes lineatus* (L.) (USA: Massachusetts and Canada: Prince Edward Island) and *Agriotes obscurus* (L.) (Canada: Prince Edward Island). New national, provincial or state records are listed for 14 native North American species.

Published December 2011

Introduction

North America is home to about 1000 described species of Elateridae (Johnson 2002), which include important invasive alien crop pests. Of nine species listed as introduced into USA (Johnson 2002) and Canada (Majka and Johnson 2008), six are known pests, namely: *Agriotes lineatus* (L.), the Lined Click Beetle (Gratwick 1992; Traugott et al. 2008); *A. obscurus* (L.), the Dusky Wireworm (Gratwick 1992; Traugott et al. 2008); *A. sputator* (L.) (Gratwick 1992; Traugott et al. 2008); *Conoderus amplicollis* (Gyllenhal), the Gulf Wireworm (Stone 1975); *C. falli* (Lane), the Potato Wireworm (Dobrovsky 1953); and *C. exsul* Sharp, the Sugarcane Wireworm (Williams 1931). This work presents the discovery of two additional species of adventive Elateridae in North America, one of which can be considered a pest species, and new findings of established pest species in Massachusetts and Prince Edward Island. New provincial and state records are provided for 13 native species. Specimens are deposited in the Canadian National Collection of Insects, Arachnids and Nematodes (CNCI), Ottawa, and other collections or with collectors, as indicated under each species.

Results

First records of new exotic species in North America

***Hemicrepidius niger* (L.)**

In 2008 a single specimen of the Eurasian elaterid *Hemicrepidius niger* (L.) was collected from Claireville Conservation Area near Brampton Ontario, during the Canadian Food Inspection Agency's (CFIA) trapping survey for invasive alien pests. Confirmation of the identity of this specimen was made by S. Laplante and H. Mendel. Finding this species, a putative crop pest wireworm, in North America caused initial concern that it might become an agricultural pest.

Subsequent fieldwork was conducted in June 2009 to assess the presence, abundance, and geographical extent of the population at the site. A collecting effort of 22 person-hours of beating and sweeping, plus five blacklight-traps (set for one night) was conducted over two days within three km of the original detection site. This effort yielded two additional specimens of *H. niger*. Conditions were sunny with high temperatures of 30–32°C, preceded by 1–2 weeks of cooler rainy weather. Insect catches were generally low. Finding these three specimens within a one-km radius over two years suggests the existence of a reproducing population of *H. niger*. In 2010, two additional specimens of this species were recovered from CFIA traps near St. John, New Brunswick. The findings in New Brunswick were 21 km from each other and 1100 km from the Ontario site, suggesting that *H. niger* is established in at least two separate agricultural regions of Canada.

The larval stage of *H. niger* was thought to be a root pest of vegetables, grains, forage crops, and possibly tree seedlings. However, recent stable-isotope analysis of this species at 11 sites in Austria and Germany indicates that it acts as a predator in its native range (Traugott et al. 2008), and is therefore likely beneficial or not important to plant production. This suggests that *H. niger* will not become a crop pest in North America, but it is unknown what impact this predator could have on soil-dwelling animals.

Label data.[1]**:** "Canada, ON, Toronto,/ Claireville CA. 17T/ 0608674W 4844539N/ 23.vi.[20]08 funnel nr. *Populus*/ Chin & Fok CFIA08-3149"; "Canada, ON, Brampton,/ Claireville CA. 43.754° N 79.64°/ W 22.vi. [20]09 beating/ *Salix* H.Douglas"; and "Canada, ON, Brampton,/ Claireville CA. 43.747° N 79.646°/ W 23.vi. [20]09 AM on *Asclepias* H.Douglas"; "Canada, NB,/ Quispamsis, 45.467°N/ -65.937°W 16.vii.2010./ EAB sticky./ K.L.Richard CFIA10-02200"; and "Canada, NB, Rockwood/ Pk. campground,/ 45.292°N -66.050°W/ 16.vii.2010. EAB sticky/. K.L.Richard CFIA10-02201".

Recognition. *Hemicrepidius niger* is a shiny, black or brown elaterid, 10–13 mm long with long pale pubescence dorsally. This species can be distinguished from all North American *Hemicrepidius* by the lack of posterior emarginations of the hypomera (that of *H. niger* resembles Fig. 8 in Johnson 2002). Because of this difference, identification of *H. niger* specimens using Johnson's (2002) key to North American genera of Elateridae should lead readers to genus *Athous*. This apparent error is because Johnson's key was not designed to diagnose non-North American members of these morphologically similar genera.

[1] A '/' in quoted label data indicates a line break.

Individuals attempting to identify specimens of *H. niger* and *A. haemorrhoidalis* using Becker's (1979) key to North American *Athous* will follow the path from couplet 1 directly to couplet 35. This is because these two species lack the triangular frontal depression (i.e., posterior to the supra-antennal carina) that would lead users to couplet 2. Otherwise the somewhat elevated frontal carina (supra-antennal carina) of *A. haemorrhoidalis* and moderately long antennomere 2 of both species would make interpretation of couplet ambiguous. At couplet 35, both can be distinguished from all subsequent species by the following combination of characters: elytral colour uniform (patterned in some species), and lobes of 3rd tarsal segments reaching to apical half of 4th tarsal segments (not reaching as far in any of the other species [Becker 1979, Leseigneur 1972]). The supra-antennal carina of *A. haemorrhoidalis* is also straight across the head in anteroventral view (this carina is depressed medially in most other species beyond couplet 35). *Hemicrepidius niger* can be distinguished from *A. haemorrhoidalis* by its broad antennomere 3, which is most similar in shape and rough texture to antennomere 4 (most like the shape and smoothness of antennomere 2 in *A. haemorrhoidalis*). Additionally, the apices of the aedeagal parameres are pointed in *H. niger* and rounded in *A. haemorrhoidalis*.

Detailed, illustrated taxonomic information is available in Jagemann (1955), Leseigneur (1972), and Platia (1994).

***Athous haemorrhoidalis* (Fabricius)**

The author examined two specimens of the European species *Athous haemorrhoidalis* (Fabricius), identified by Serge Laplante. A third specimen of this species was found in CFIA insect survey material. These three Ontario specimens represent the first records from Canada. This species is an apparent pest of below-ground parts of crop and forage plants in its native range (Gratwick 1992), indicating that it could also become a pest in North America.

Detailed images of additional specimens of *A. haemorrhoidalis* were found on the internet (Harvard University 2010). A specimen from Boston Harbour Islands National Recreation Area in Massachusetts represents the first record of this pest species from USA. The specimen shown on this website bears an identification label by Serge Laplante, and the diagnostic characters of *A. haemorrhoidalis* were clearly visible in the photographs. Although this record is publicly available on the internet, this paper represents the first published record of *A. haemorrhoidalis* from USA in the scientific literature. The presence of specimens of *A. haemorrhoidalis* at four sites in each of three regions separated from each other by 400 to 700 km suggests that reproducing populations of this species may be established in North America.

Label data. "ONT. Ottawa/ 6.vi.2003/ J. R. Vockeroth"; "Damp second/ growth *Acer*-/ *Betula* wood"; same data except date is: 8.vi.2003; "Canada, ON, Toronto,/ Sunnybrook Park 17T 0632469/ E 4842151 N 4.vi.2007. funnel./ Harvey & Chin CFIA07-1246"; "USA: MA, Plymouth, World's/ End, (WE-MAL-1 11.06)/ (42°15'39.7"N, 70°52'14.5"W/ 6-13 vi 2006, malaise trap/ coll. J. Rykken". In addition to the World's End Island record, the same database reports additional specimens from nearby Ragged Island, with four specimens recorded in total.

Recognition. *Athous haemorrhoidalis* is a shiny, black or brown elaterid, 10–15 mm long with pale pubescence dorsally. Diagnostic characters are described above in the treatment

of *H. niger*. Detailed, illustrated taxonomic information can be found in Leseigneur (1972) and Platia (1994).

Additional records of exotic species already known from North America

***Agriotes lineatus* (L.)**

Agriotes lineatus is an important crop pest in Europe (Gratwick 1992; Traugott et al. 2008), and is a probable pest in western Canada (Vernon and Päts 1997). The known distribution of this species in North America is Canada: British Columbia, Newfoundland, Nova Scotia (Becker 1956), Prince Edward Island (present study) and USA: Massachusetts (present study), Washington, and Oregon (LeGasa et al. 2006).

Label data. "USA: MA, Suffolk, Thompson/ Island, (TH-BLITZ 10.06)/ 42°19'2"N, 71°0'31"W/ 10 vi 2006/ BLITZ # 185-1" (det. by S. Laplante). Identity verified through photographs on internet (Harvard University 2010). In addition to the Thompson Island record, the same database reports additional specimens from nearby Bumpkin Island, Calf Island, and Snake Island (ten specimens). "CANADA, PE,/ Hazelbrook, 6 June 2007, C. Noronha"; "CANADA, PE,/ Crossroads, 11 July 2007, C. Noronha"; "CANADA, PE,/ China Point, 27 June 2007,/ C. Noronha"; "CANADA, PE,/ Mermaid, 20 June 2007,/ C. Noronha" (17 specimens, 2 in CNCI, remainder returned to C. Noronha).

***Agriotes obscurus* (L.)**

This species has been found to be a plant pest affecting a wide variety of crops in its native range (Traugott et al. 2008). It is native to much of Northern Eurasia and was first collected in North America in Nova Scotia ca. 1859 (Becker 1956). Newly recorded here for Prince Edward Island.

Label data. "CANADA, PE,/ Crossroads, 6 June 2007,/ C. Noronha"; "CANADA, PE,/ Lake Verde, 12 June 2007,/ C. Noronha"; "CANADA, PE,/ Hazelbrook, 4 July 2007,/ C. Noronha"; "CANADA, PE,/ Victoria, 12 June 2007,/ C. Noronha" (10 specimens, 2 in CNCI, remainder returned to C. Noronha)..

New records of native North American species

Agriotes collaris (LeConte). New to Colorado and West Virginia (2 specimens, Colorado State University Collection): "Pike Co. CO/ 26 May 1996/ B. Kondratieff/ Kleinhans Cr./ Cypress Lane"; "Pocahontas Co. WV/ 24 May 1994/ Kondratieff & Fitzgerald, headwaters/ Sugar Cr., FS Rd. 76".

Agriotes fucosus (LeConte). New to Colorado and Nebraska (4 specimens, Colorado State University Collection): "Blaine Co., NE/ 13 June 2000/ B. Kondratieff/ & R. Zuellig/ N. Loup R., CR1"; "Ft. Collins Col.. 6/4/[18]99"; "Colo/ 1887"; "Ft. Collins/ Col 5-13-[19]10".

Ampedus rubricollis (Herbst). New to Louisiana (1 specimen at CNCI, 2 returned to N. Schiff): 1X "LA: Grant Parish,/ Iatt Lake Bottomlands/ 30 Mi. N. of Alexandria/ 1-15 May 1998/ A. Brazel, N. Schiff" and 2X LA: "Grant Parish,/ Iatt Lake Bottomlands/ 30 Mi. N. of Alexandria/ 15 April-May 7 1998/ A. Brazel, N. Schiff". New to Missouri (2 specimens, returned to N. Schiff): "MO: Reynolds Co./ Deer Run State Forest/ Intersect Rd. 1 and Rd 9/ 30 May 30 June 2006/ R.J. Marquis, N. Schiff".

Ampedus sayi (LeConte). New to Missouri (1 specimen, returned to N. Schiff): "MO: Reynolds Co./ Deer Run State Forest/ Intersect Rd. 1 and Rd 9/ 30 May-30 June 2006/ R.J. Marquis, N. Schiff".

Athous aterrimus Fall. New to Canada and Alberta (5 specimens, CNCI): "Canada, AB, Ft. McMurray,/ tar sands, A site, 7.vii.[20]05, Lindgren w./ UHR EtOH & conophthorin. Trap 16./ CFIA 05-3121 Alejos & Solomone". This is a surprising extension because *A. aterrimus* was previously only known from Oregon and California (Giant Forest). The specimens from Alberta match the diagnostic characters for this species (Becker 1979) and specimens at CNCI. The most distinctive observed shared characteristics include a pair of pubescence convergence points on the male abdominal ventrite 5 and aedeagal morphology (long phallobase; and short broad paramere blades apical to abrupt emarginations). The only observed difference between the Alberta series and the CNCI *A. aterrimus* specimens is the shape of the paramere blades (convex throughout vs. concave in the midsection, respectively). Until further taxonomic research is done, it seems best to consider these specimens as belonging to *A. aterrimus*.

Athous ornatipennis (LeConte). New to Missouri (1 specimen, CNCI): "MO: St. Louis Co./ Tyson Research Station/ W. Ridge Rd., Eureka/ 38.31°N, 90.33°W/ 1-10 April 2007 MT/ R. Marquis, N. Schiff".

Athous productus (Randall). New to Alberta (2 specimens, CNCI): "Canada, AB, Ft./ McMurray, tar sands,/ Syncrude, 23.vi.[20]05,/ Lindgren w. UHR EtOH &/ alpha pinene. Trap 14./ 05-2033. Alejos &/ Solomone" and "Canada, AB, Ft./ McMurray, tar sands, Suncor, 9.VI.[20]05, Lindgren/ w. ipsenol & ipsdienol./ Trap 6. Alejos and/ Saomone".

Esthesopus claricollis (Say). New to Canada (Ontario) (1 specimen, University of Guelph Insect Collection): "ONT: Kent Co., Rondeau P./ P., Group Campground, / 42°17'35"N 81°50'52"W/ Carol forest malaise/black light, 20-22 Jul 2004, S.M. Paiero, DEBU01140539".

Hypnoidus rivularius (Gyll.). New to Alberta (2 specimens, CNCI): "Canada, AB, Ft./ McMurray, tar sands,/ Suncor, 9.VI.[20]05, Lindgren/ w. UHR EtoH &/ salicylaldehyde. Trap 1./ Alejos and Saomone"; and "Canada, AB, Ft./ McMurray, tar sands, B/ site, 9.VI.[05], Lindgren w./ UHR EtoH &/ Salicylaldehyde. Trap 4./ Alejos and Saomone".

Lacon auroratus (Say). New to Nova Scotia (2 specimens, CNCI): "Canada, NS, Pictou Co./ Folly Mountain, 20T 458454E 5031889N/ 16.vii.2007. funnel./ McDonald & Linds/ CFIA07-4328" and "Canada, NS, Colchester Co.,/ E. Folly Mt. 20T 458554E/ 5031889N 30.vii.2007./ funnel. McDonald & Linds/ CFIA07-5516".

Limonius basilaris (Say). New to Louisiana (1 specimen returned to N. Schiff): "LA: St. Tammany Parish/ Covingdon, 19 April-13 May/ 2001. M. Devall, N. Schiff".

Pityobius anguinus LeConte (Say). New to Louisiana (1 specimen returned to N. Schiff): "LA: St. Tammany Parish/ Covingdon Malaise Trap/ 25 May-6 June 1998. M. Devall, N. Schiff".

Pseudanostirus nigricollis (Bland). New to New Brunswick (2 specimens, CNCI): "Canada, NB, 19T /0637197 5244649/ 3.vii.2007. funnel./ A.Couturier CFIA07-/2749" and

"Canada, NB, Scott Siding,/ 19T E613389 N5085445/ 30vi.2008. funnel α-pinene,/ trans verbenol A.McIntosh/ CFIA 08-5108".

Discussion

A series of Canadian Department of Agriculture interceptions of exotic species suggests that some of above-mentioned introductions may have been a result of intercontinental trade in woody plants rooted in soil during the early 1960s, before such movement was prohibited. The CNCI has 14 larval specimens of *A. haemeroidalis* intercepted in shipments of *Azalea, Pinus, Juniperus* and *Taxus* with soil to Canadian ports including Montreal, St. John, and Toronto from Belgium and Holland between 1961 and 1963. The same material also contained a larval specimen identified as possibly *Athous niger* (L.) (= *Hemicrepidius niger*) intercepted in Ontario in 1962 from Holland. Other exotic species intercepted in this trade included *Athous vittatus* (Fabricius) (not known from North America), *Actenicerus sjaelandicus* (Müller) (not known from North America, Majka and Johnson 2008), *Dalopius marginatus* Esch. (not known from North America) and *Agriotes* spp. These interception records not only suggest possible origins of the known introduced species presented here, but also that populations of several additional species may exist undetected in North America. The history of any such elaterid interceptions in USA from Europe may also be useful to examine.

The additional records of native species presented here extend, or fill in gaps in, known distributions. While this is a potentially endless process of adding geographic detail at an increasingly fine scale, such records are useful for other reasons. Beyond telling us where species occur, having such information may indicate ecological change or help detect newly introduced species. For example, a finding that a putatively native species has rapidly increased its range may indicate that it is not native at after all, or that it has been confused with a newly arrived, morphologically similar, non-native species.

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INSECT COLLECTIONS FROM POLAR BEAR PROVINCIAL PARK, ONTARIO, WITH NEW RECORDS

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Abstract

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New records are presented for species of Diptera (18), Coleoptera (10), Lepidoptera (7), Hymenoptera (5), Odonata (3), and Orthoptera (1) collected in 2009 during a 9-day period in Polar Bear Provincial Park, coastal northern Ontario. These include the first Ontario record of *Lucilia magnicornis* (Siebke) (Diptera: Calliphoridae); new northern ranges for *Chrysops sordidus* Osten Sacken and *C. zinzalus* Philip (Diptera: Tabanidae); three other, rarely collected flies: *Protocalliphora spatulata* Sabrosky, Bennett, and Whitworth (Diptera: Calliphoridae), *Helophilus lapponicus* Wahlberg, and *H. groenlandicus* (Fabricius) (Diptera: Syrphidae), and the tiger moth *Grammia quenseli* (Paykull) (Lepidoptera: Erebidae).

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Introduction

The purpose of this paper is to report on insects caught at Burnt Point Field Station, operated by the Ontario Ministry of Natural Resources (OMNR). This site, accessible only by plane, is located in Polar Bear Provincial Park. Established in 1970, the Park consists of a 2.4 million hectare wilderness-class area along the southern Hudson Bay and northwestern James Bay coasts, 54–56°N and 82–87°W (OMNR 2011). The terrain at Burnt Point is mainly low-lying tundra in the Hudson Plains ecozone. Collections were obtained while conducting a multi-year biting fly trap comparison study being carried out in conjunction with the Far North Information and Knowledge Management Plan initiative of the OMNR Far North Terrestrial Biodiversity project. The Plan's goal is to catalogue the distribution and diversity of species within the various ecosystems of northern Ontario, thus providing data to inform management strategies for both conservation and development.

Materials and Methods

The OMNR Burnt Point Field Station is 75 km east of the community of Peawanuck at 55°14'29.5"N, 84°19'04"W, in the middle of a 5–10 km flat region of shallow fen pools and gravel ridges between the Hudson Bay coast and the edge of boreal forest. Sampling took place from 7–15 August 2009. Hourly temperatures for the collecting period were recorded using a Thermocron I-button® data logger (model DS1921G). The weather throughout the collecting period was cool, windy, often rainy and/or foggy. The mean temperature was 12°C (SD = 5.7), with only two days when temperatures exceeded 25°C. During the study period, there were 110, 65, 29, and 11 accumulated degree days above 0, 5, 10, and 15°C temperature thresholds, respectively. Daily catches were consequently often low. Insects were collected by hand, by net, and from two Nzi traps (specifically designed to collect biting flies), one made of cloth and the other of Coroplast® (Mihok 2002; Beresford and Sutcliffe 2006; Mihok and Carlson 2007). An Nzi trap is 125 cm wide and 80 cm high, with a black, central target flanked by blue panels, the whole surmounted by a netted funnel to direct insects into a collecting bottle. Any insects that were not within the collecting bottle at the top of the traps were removed using a modified battery-operated hand-held vacuum (Dust Buster®). Collections from both Nzi traps were preserved in vials with 80% ethanol at the end of each day, and stored until pinned for identification in Peterborough. Host-seeking mosquitoes were sampled by placing a vial over any mosquitoes that attempted to bloodfeed from my face or arms. Netted or hand-caught insects were killed with ethyl acetate and then pinned. All pinned specimens and trap collections are stored as vouchers in the Biology Department, Trent University.

The collected insects were identified using relevant taxonomic keys as follows: for Coleoptera, Lindroth (1961–1969) (current Latin names checked using Bousquet and Larochelle 1993) (Carabidae), Yanega (1996) (Cerambyicidae), Larson et al. (2000) (Dytiscidae), and Anderson and Peck (1985) (Silphidae); for Diptera, Whitworth (2006) and Marshall et al. (2011) (Calliphoridae), Wood et al. (1979) and Thielman and Hunter (2007) (Culicidae), Vockeroth (1992) and Skevington et al. (2006) (Syrphidae), Teskey (1990) and Thomas and Marshall (2009) (Tabanidae); for Hymenoptera, Packer et al. (2007) and Laverty and Harder (1988) (Apidae), Buck et al. 2008 (Vespidae); for Lepidoptera, Layberry et al. 1998 (Hesperiidae, Lycaenidae, Nymphalidae, Pieridae), Schmidt (2009) (Arctiidae); for Odonata, Walker (1953, 1958) and Walker and Corbet (1975); and for Orthoptera, Vickery and Kevan (1985). Identifications were confirmed by other researchers when required (Table 1, footnotes). New range records were based on published range maps found in the literature, or personal communication where indicated.

Results and Discussion

The list of species caught is presented in Table 1. As far as I can determine, most are the first published records for Polar Bear Provincial Park except for the species of Arctiidae and Silphidae. The new records are not surprising as insect diversity in the coastal region of northern Ontario is greatly understudied compared to southern Ontario due to inaccessibility

TABLE 1. Species collected at Burn Point Field Station, Polar Bear Provincial Park, 7–15 August 2009. Identifications confirmed by other researchers are listed in the footnotes.

Order/Family/Species	Date	Collection method	Habitat	Number collected
COLEOPTERA				
Carabidae				
Pterostichus punctatissimus (Randall)	8 August	hand	gravel ridge	1
Stereocerus haematopus (Dejean)	12 August	hand	gravel ridge	1
Cerambycidae				
Monochamus scutellatus scutellatus (Say)	16 August	hand	out building	1
Dytiscidae				
Agabus arcticus (Paykull)	10 August	net	fen pool	1
Carrhydrus crassipes Fall	10 August	net	fen pool	1
Hygrotus novemlineatus (Stephens)	10 August	net	fen pool	1
Ilybius discedens Sharp	10 August	net	fen pool	2
Ilybius pleuriticus LeConte	10 August	net	fen pool	2
Ilybius vittiger (Gyllenhal)	10 August	net	fen pool	2
Silphidae				
Thanatophilus lapponicus (Herbst)	8 August	hand	under garbage	10
DIPTERA				
Calliphoridae				
Calliphora terraenovae Macquart	10, 14 August	Nzi traps		3
Cynoma cadaverina (Robineau-Desvoidy)	11–14 August	Nzi traps		4
Lucilia magnicornis (Siebke)	12 August	cloth Nzi trap		1
Protocalliphora spatulata Sabrosky, Bennett, and Whitworth[1]	14 August	cloth Nzi trap		2
Protophormia terraenovae (Robineau-Desvoidy)	8 August	Nzi traps		3
Culicidae				
Aedes abserratus (Felt and Young)	6–16 August	hand		1
Aedes nigripes (Zetterstedt)	6–16 August	hand		17
Syrphidae				
Chamaesyrphus sp.	10 August	cloth Nzi trap		2
Helophilus groenlandicus (Fabricius)[2]	12 August	net	gravel ridge	1
Helophilus lapponicus Wahlberg[2]	8 August	net	gravel ridge	1
Parasyrphus nigritarsus (Zetterstedt)	13 August	net	gravel ridge	1
Parasyrphus tarsatus (Zetterstedt)	13 August	net	gravel ridge	1
Tabanidae				
Chrysops excitans Walker	8–13 August	cloth Nzi trap		1
Chrysops furcatus Walker	8–13 August	Nzi traps and net		10
Chrysops mitis Osten Sacken	8–13 August	cloth Nzi trap		1

TABLE 1 Cont'd...

Order/Family/Species	Date	Collection method	Habitat	Number collected
Chrysops nigripes Zetterstedt	8–13 August	Nzi traps and net		75
Chrysops sordidus Osten Sacken	8–13 August	Nzi traps and net		10
Chrysops zinzalus Philip	8–13 August	Coroplast Nzi trap		1
HYMENOPTERA				
Apidae				
Bombus borealis Kirby	13 August	net	gravel ridge	1
Bombus polaris Curtis	9–10 August	net	gravel ridge	2
Bombus sylvicola Kirby	8–13August	net	gravel ridge	7
Bombus terricola Kirby	13 August	net	gravel ridge	1
Vespidae				
Dolichovespula norwegica (Fabricius)	9 August	net	ground nest	2
LEPIDOPTERA				
Erebidae				
Grammia quenseli (Paykull)[3]	11 August	net	gravel ridge	1
Hesperiidae				
Pyrgus centaureae (Rambur)[4]	10 August	net	gravel ridge	1
Lycaenidae				
Lycaena dorcas Kirby[4]	13 August	net	gravel ridge	2
Nymphalidae				
Coenonympha tullia (Müller)[4]	10 August	net	gravel ridge	2
Pieridae				
Colias gigantea Strecker[4]	10, 13 August	net	gravel ridge	3
Colias interior Scudder[4]	10, 13 August	net	gravel ridge	3
Colias palaeno chippewa Edwards[4]	10, 13 August	net	gravel ridge	2
ODONATA				
Aeshnidae				
Aeshna sitchensis Hagen[4]	13 August	net	gravel ridge	2
Libellulidae				
Somatochlora albicincta (Burmeister)[4]	11 August	net	gravel ridge	4
Sympetrum danae (Sulzer)[4]	13 August	net	gravel ridge	2
ORTHOPTERA				
Acrididae				
Melanoplus borealis borealis (Fieber)	11–14 August	net	gravel ridge	4

[1] Terry Whitworth (Washington State University, Pullman, Washington)
[2] Jeffrey Skevington (Canadian National Collection of Insects, Ottawa, Ontario)
[3] Christian Schmidt (Canadian Food Inspection Agency, Ottawa, Ontario)
[4] Colin Jones (Ontario Ministry of Natural Resources, Peterborough)

of much of the northern part of the province. Thus, any reporting on species collected from this area adds to our knowledge of species distributions, contributing important information on the ecology of these regions (Danks 1981). Along the coast of Hudson Bay and James Bay, the nearest other historic collecting sites in Ontario are Fort Severn to the west, Fort Albany and Moosonee to the south and, to the east in Quebec, a few localities from Great Whale River south. Specimens from the Moosonee and Quebec sites were collected mainly by staff from the Canadian National Collection of Insects, Ottawa, during the Northern Insect Survey, conducted from 1947–1958 [maps of collecting sites given in Freeman and Twinn (1954, figure 1), and Huckett (1965, map 1)]. Butterflies have also been collected along the east coast of James Bay (Hess 1993). All the sites are hundreds of kilometres from the current study site and, as far as known, few of the insect records from them have been published—mainly butterflies (Hess 1993; Layberry et al. 1998) and mosquitoes (Wood et al. 1979). Most of the records reported here fill in a large distributional gap, even for species that are known to be widespread in Canada.

Atypical collecting methods can produce surprising results. Nzi traps were designed for catching biting flies, such as horse flies (Tabanidae) and stable flies (Stomoxinae). They generally catch low numbers of non-targeted species such as blow flies (Calliphoridae). One possible explanation for the blow flies reported here is that they were attracted to the warm surface of the traps, which presented a prominent target in the flat landscape of the collecting site.

New Ontario records and range extensions for 17 species are discussed further here.

Lucilia magnicornis (Siebke) (Diptera: Calliphoridae) (Marshall et al. 2011) is a rarely collected northern species of blow fly, recorded previously from Alaska to Labrador. This is the first report for Ontario.

Protocalliphora spatulata Sabrosky, Bennett and Whitworth (Diptera: Calliphoridae) was collected in the Nzi traps. Only two specimens if this species of bird blow fly were obtained. This species is found in the far north or at high elevations, with most records being from western North America. As far as I can determine, only one other Ontario record exists, from the Ogoki region of inland northern Ontario (Sabrosky et al. 1989). The larvae are parasitoids of fledgling birds, and *P. spatulata* has been reported from horned larks, American pipits, rosy finches (Sabrosky et al. 1989), savannah sparrows, and white-crowned sparrows in Alaska (Fair and Miller 1995).

Calliphora terraenovae Macquart (Diptera: Calliphoridae) is a widespread, relatively uncommon species (Marshall et al. 2011), previously collected from Labrador and southern Ontario. This is the first record from northern Ontario.

Protophormia terraenovae (Robineau-Desvoidy) (Diptera: Calliphoridae) is a Holarctic species. One of the most abundant blow fly species on the Russian tundra (Vinogradova 1993), it is generally less common in Canada (Marshall et al. 2011). The range map from Marshall et al. (2011, University of Guelph Insect Collection database) reflects this, with a record gap between Churchill, Manitoba and mid to southern Ontario.

Cynoma cadaverina (Robineau-Desvoidy) (Diptera: Calliphoridae) is a common species, known from Ontario, James Bay and the Manitoba coast. This is a first, but not unexpected, report from the Hudson Bay coast of Ontario.

Chrysops sordidus Osten Sacken and *C. zinzalus* Philip (Diptera: Tabanidae) are new range records for northern Ontario. Distribution maps show northern catches from the southern tip of James Bay in Quebec, and previous Ontario records are from the Great Lakes region, particularly around Lake Superior (Thomas and Marshall 2009). The other four deer fly species were expected from Polar Bear Provincial Park.

Aedes nigripes (Zetterstedt) (Diptera: Culicidae) is a tundra species. Polar Bear Provincial Park occurs at the southern edge of its distribution in central Canada. The records from Polar Bear Provincial Park fill in a gap between catches reported from the Quebec and Manitoba coastlines (Wood et al. 1979). *Aedes abserratus* (Felt and Young), largely associated with bogs, tends to be a more southern species, with reported catches in northern Ontario previously from the James Bay region and northern Quebec (Wood et al. 1979).

Helophilus lapponicus Wahlberg and *H. groenlandicus* (Fabricius) (Diptera: Syrphidae) are rarely caught Holarctic northern species (Skevington et al. 2006). Although generally found in low tundra habitat (Danks 1981), both species have been caught in a black spruce peatland forest 50 kilometres north of Cochrane, Ontario (Deans et al. 2007).

Dolichovespula norwegica (Fabricius) (Hymenoptera: Vespidae), a widespread Holarctic species, was caught at a nest located in the ground under a dense thicket of willow shrubs on a gravel ridge, substantiating observations that this species nests underground (Buck et al. 2008).

Among the four bumble bee species (Hymenoptera: Apidae) collected, *Bombus sylvicola* Kirby and *B. polaris* Curtis are commonly found along the Hudson Bay coastal region, whereas *B. borealis* Kirby and *B. terricola* Kirby tend to be more southern species, with previous northern records from the James Bay area (Laverty and Harder 1988).

Grammia quenseli (Paykull) (Lepidoptera: Arctiidae) is an arctic/alpine species. I am aware of only two other records from Ontario for this species, one from Cape Henrietta Maria (within Polar Bear Provincial Park) collected in 1948 (Don Sutherland, personal communication), and one from Shagamu River, Kenora District (Robertson 1994).

Melanoplus borealis borealis (Fieber) (Orthoptera: Acrididae) was caught along a gravel ridge beside a fen pool, typical habitat for this species (Vickery and Kevan 1985). The species occurs across Canada, with a northern distribution from the Hudson Bay coastline west to Alaska (Vickery and Kevan 1985).

All of the beetles collected have reported ranges that encompass the study region.

Conclusions

Large-scale changes in habitat such as those associated with a changing climate, land use, or increased accessibility, have the potential to alter species composition and/or bring invasive species into the Hudson Bay lowlands (Fernandez-Triana et al. 2009). The ability to quantify such effects (see for example, Fernandez-Triana et al. 2011) depends on knowing the extent and consistency of current insect species distribution. This paper presents a small sample of the larger insect species caught during the first year of a multi-year biting fly trap survey in Polar Bear Provincial Park, presenting new distribution records—necessary data for assessing future changes in insect diversity within this Park.

Acknowledgements

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HYLAEUS PUNCTATUS (HYMENOPTERA: COLLETIDAE), A BEE SPECIES NEW TO CANADA, WITH NOTES ON OTHER NON-NATIVE SPECIES

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Abstract *J. ent. Soc. Ont.* 142: 29–43

Hylaeus punctatus (Brullé) (Colletidae; Hylaeinae), the second species of the Old World subgenus *Spatulariella* recorded in the Western Hemisphere, is reported in Canada for the first time. A diagnosis for recognizing the subgenus among the Canadian fauna and a key to distinguish the two species are provided. Additionally, we provide a brief summary of non-native bee species in Canada.

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Introduction

A recent "General Status of Species in Canada" assessment for Canadian bee species compiled 803 species, with the highest diversity in southern areas bordering the United States (Canadian Endangered Species Conservation Council, in preparation). New bee species are still being described in Canada (Gibbs 2010; Rehan and Sheffield 2011), and new distributional records are frequently being added (Gibbs 2010; Dumesh and Sheffield in press; Sheffield et al. in press), most of these as northern range extensions from the adjacent United States. Areas of Canada bordering the United States are thus particularly important in terms of receiving and/or intercepting non-native species (Cane 2003; Sheffield et al. 2010).

Introduced species are considered among the greatest threats to local biodiversity (Wilson 1999; Chivian and Bernstein 2008). Therefore, noting the presence and time of establishment of non-native insects, including bees, within a region is critical to monitor effectively the potential impact of these species on the indigenous fauna (Cane 2003; Sheffield et al. 2010). It is also important to understand the biology of these species, including, for bees, establishing their patterns of floral use and nesting-site preferences. Many introduced species share floral resources and compete for nesting sites with native species (Barthell et al. 1998), especially in urban settings (Matteson et al. 2008). Such data are also important for developing predictive models to determine the likely range of suitable

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habitat and ultimate distribution (Hinojosa-Díaz et al. 2005; Strange et al. 2011). In the last few decades, several Old World bee species have been recorded for the first time in Canada, from Ontario (Smith 1991; Paiero and Buck 2004; Buck et al. 2006; Sheffield et al. 2010), most of which have subsequently established populations.

Here, we report a non-native species, *Hylaeus* (*Spatulariella*) *punctatus* (Brullé) in Canada. This species is one of two *H.* (*Spatulariella*) species now established in North America (Ascher 2001; Ascher et al. 2006; Tonietto and Ascher 2008). We give a diagnosis of the subgenus and provide a key to the two species of *H.* (*Spatulariella*) known to be present in North America. Additionally, we provide a summary of the other 16 non-native bee species in Canada.

Results

First records of a new exotic species in Canada

***Hylaeus* (*Spatulariella*) *punctatus* (Brullé).** *Hylaeus punctatus* was first collected in North America in 1981 at Playa del Rey, Los Angeles Co., California (Snelling 1983) and, shortly after, recorded in South America at Santiago, Chile (Toro et al. 1989). More recently, it was discovered further east in North America, first from the District of Columbia (Ascher et al. 2006), and later in New York (Matteson et al. 2008) and Colorado (Ascher and Pickering 2011). We collected fourteen specimens, deposited in the Packer Collection, York University (PCYU) and the Canadian National Collection of Insects, Arachnids and Nematodes (CNC), with the following data: CANADA. Ontario: Toronto, York University campus, 43.7753°N 79.5056°W, 196m, 27.vii.2011, S. Dumesh, M. Cheryomina, C. Sheffield (9♂); same locality, 29.vii.2011, C. Sheffield (5♂) and 30.vii.2011, C. Sheffield (1♀). All specimens were collected on wild carrot, *Daucus carota* L. (Apiaceae). In sweeps of these plants, 44% of the *Hylaeus* captured were males of *H.* (*Spatulariella*): *H. hyalinatus* 26% and *H. punctatus* 18%. Gosek et al. (1995) suggested *H. punctatus* as a potential pollinator of carrot; this affinity may be useful for monitoring its further spread in North America. The lack of distributional data between western locations, i.e., California, Colorado, and eastern North America may represent multiple introductions and/or lack of detection due to "no" sampling. *Hylaeus punctatus* probably nests in pre-existing cavities (Westrich 1990), which likely facilitated its arrival into North America (Ascher 2001) and subsequent spread.

The arrival of *H. punctatus* in Canada appears to be recent, as pan trap surveys on York University campus between 2004 and 2006 (Colla et al. 2009) failed to detect it (or *H. hyalinatus*) among the 248 specimens of *Hylaeus* collected. Neither species was collected in the 2002-2003 survey of Grixti and Packer (2006) approximately 20 km northeast of York University campus, though other surveys in southern Ontario have detected *H. hyalinatus* in low numbers: in 2003 in St. Catharines, Ontario, only two *H. hyalinatus* were collected among 1729 *Hylaeus* specimens (Richards et al. 2011). In a survey in Hamilton (Royal Botanic Gardens) 6 out of 112 *Hylaeus* specimens were *H. hyalinatus* (Andrachuk, unpublished). However, the numbers of *H. punctatus* recorded here may suggest that this species has been in Ontario for several years, though undetected, as very few have been caught in pan traps relative to indigenous species (Colla et al., 2009; Richards et al. 2011;

Andrachuk, unpublished), despite the subgenus being proportionally very abundant on *Daucus* florets.

Diagnosis and key to species of *Hylaeus* (*Spatulariella*) in North America.

The subgenus is distinguished from other North American *Hylaeus* subgenera by the presence of a lamelliform carina between anterior and lateral faces of the mesepisternum in both sexes (Figures 1a, 1c; easiest to see in ventrolateral view), which is absent in the other subgenera found in Canada (Figures 1b, 1d). Males of this subgenus are further distinguished by the spatulate apex of sternum 8 (Figure 5a), which often protrudes from the genital opening.

The following key (modified from Ascher 2001) can be used to distinguish the two species of *H.* (*Spatulariella*) in North America, and can be used with Mitchell (1960) and Romankova (2007) for identifying species in eastern Canada.

1 Females.....2
Males.....3

2(1) Face with long lateral maculations that fill most of the lower paraocular area (Figure 2a); mesopleuron with distinct shining interspaces among the punctures (Figure 3a), the punctures similar in size to those on the mesoscutum (Figure 3c), especially anterior to episternal groove (Figure 3a)..... *H. hyalinatus* Smith

– Face with lateral maculations reduced (Figure 2c); mesopleuron more coarsely and closely punctate, without shining interspaces among the punctures (Figure 3b), the punctures generally larger and deeper than those on the mesoscutum (Figure 3d)..... *H. punctatus* (Brullé)

3(1) Sternum 8 with distal spatulate process rounded apically, connected to the base by an extremely narrow elongate stalk (Figure 5a); face with extensive yellow maculation, the supraclypeal area nearly entirely pale, with lateral face marks extending on the eye margin to well above antennal base (Figure 2b); pleura with distinct shining interspaces among the punctures (Figure 4a), the punctures similar in size to those on mesoscutum (Figure 4c).....*H. hyalinatus* Smith

– Sternum 8 with distal process bi-lobed (emarginated apically), connected to the base by a broad stalk (Figure 5b); face with pale maculations less extensive, supraclypeal area black (Figure 3d) or with yellow band restricted to apical half (Figures 3e and 3f), lateral face marks reduced and seldom extending above epistomal sulcus (Figure 3d-3f); pleura more coarsely and closely punctate, without shining interspaces among the punctures (Figure 4b), the punctures generally wider and deeper than those on mesoscutum (Figure 4d)..... *H. punctatus* (Brullé)

Notes on other exotic bee species in Canada

COLLETIDAE

***H.* (*Spatulariella*) *hyalinatus* Smith**. This European species (also discussed above) was first reported in North American in 2001 (Ascher 2001) from collections made between

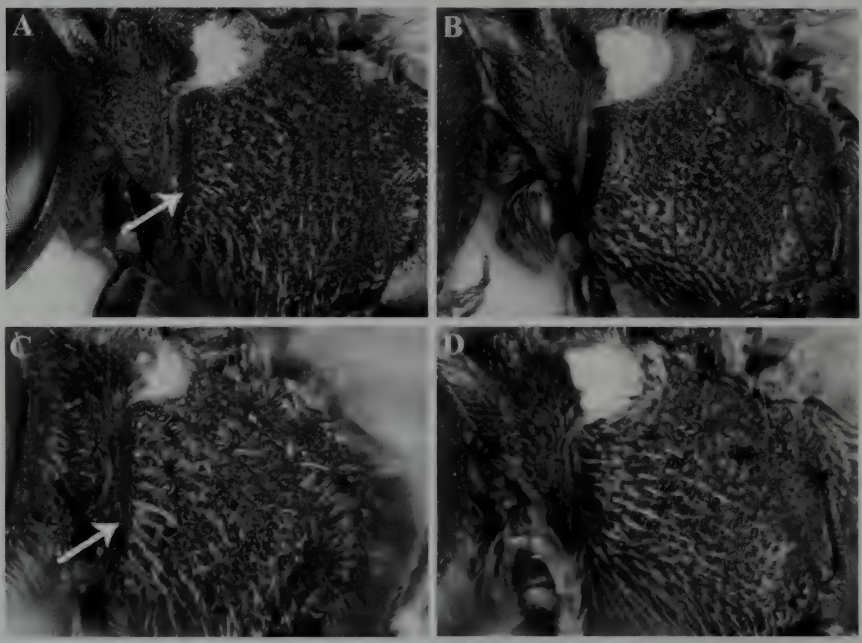

FIGURE 1. Distinguishing characteristic of *Hylaeus* (*Spatulariella*). Female (A) and male (C) of *H.* (*Spatulariella*) with visible lamelliform carina extending from pronotal lobe to forecoxa. Female (B) and male (D) of *Hylaeus* (*Prosopis*) without visible carina.

1997 and 2000 in New York. It was reported in southern Ontario shortly after (Buck et al. 2006), though the material examined in that study suggested it has been in North America (Canada) since 1993. It is a cavity-nesting species (Ascher 2001).

***Hylaeus leptocephalus* (Morawitz)**. Snelling (1970) indicated that this cavity-nesting species (as *H. stevensi* (Crawford)) was not closely related to any *Hylaeus* in the Nearctic region, and was virtually identical to the Palearctic *H. bisinuatus* Förster. Both are now considered synonyms of *H. leptocephalus*. This common species is found throughout the United States and southern Canada (British Columbia-Nova Scotia), and is possibly an oligolege of *Melilotus*, also introduced from the Palearctic region (Snelling 1970; but listed as polylectic by Cane (2003)). *Hylaeus leptocephalus* has been in North America since 1912 (collected in Fargo, North Dakota), and was first collected in Canada (Alberta) in 1916 (Snelling 1970).

ANDRENIDAE

***Andrena wilkella* (Kirby)**. This species occurs naturally in Europe and northern Asia, and is now common throughout northeastern North America. *Andrena wilkella* has been in North America since the 1800s (Malloch 1918) and, like the other ground-nesting species

FIGURE 2. Facial maculation patterns of *Hylaeus* (*Spatulariella*) in North America. Female (A) and male (B) of *H. hyalinatus*. Female (C) and male (D–F) of *H. punctatus*; D–F show variation in males of *H. punctatus*, ranging from no maculation on supraclypeal area and reduced maculation on lower paraocular area (D) to a band on apical 1/4 (E) to 1/2 (F) of supraclypeal area and more extensive maculation on lower paraocular area.

discussed below, it may have arrived in the New World through the importation and release of dry ballast, e.g., rock, sand, soil (Giles and Ascher 2006; Sheffield et al. 2010).

HALICTIDAE

***Lasioglossum leucozonium* (Schrank)**. This ground-nesting species occurs naturally in Europe and northern China, and probably has been in North America since the 1800s (Droege 2008). *Lasioglossum leucozonium* was recently collected in Alberta (specimens in PCYU), well outside the range reported by McGinley (1986). More sampling in locations between the documented range given in McGinley (1986) and these western records is required to know the full extent of its distribution in North America.

***Lasioglossum zonulum* (Smith)**. This "Holarctic" species (McGinley 1986) is also believed to be introduced (Giles and Ascher 2006) due to its phylogenetic position in the Old World *leucozonium* species group (Packer 1998; Danforth and Ji 2001). *Lasioglossum zonulum* has been in Canada since at least the mid-1800s, previously identified by Provancher (1882) as *Halictus discus* Smith (as *L. discum*) (Sheffield and Perron, unpublished). Though the

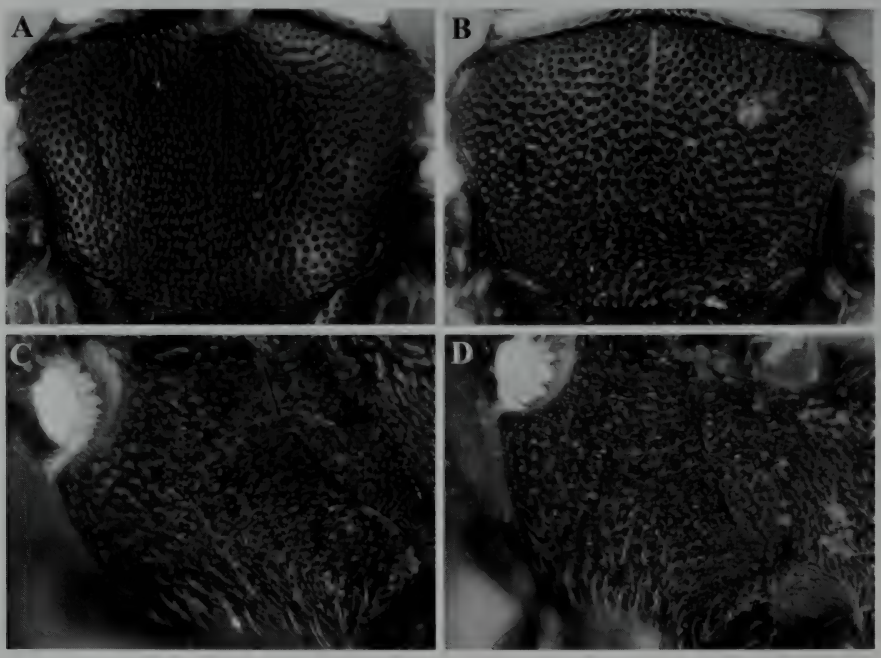

FIGURE 3. Distinguishing characters for females of *Hylaeus* (*Spatulariella*) in North America. Mesoscutum of female (A) *H. hyalinatus*, and (B) *H. punctatus*; mesopleuron of female (C) *H. hyalinatus*, and (D) *H. punctatus*.

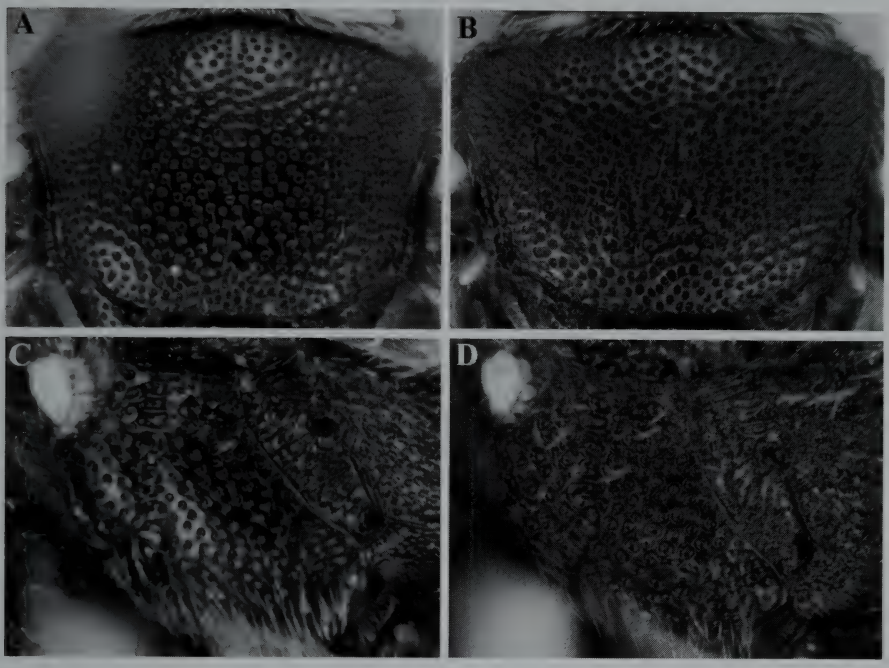

FIGURE 4. Distinguishing characters of male *Hylaeus* (*Spatulariella*) in North America. Mesoscutum of male (A) *H. hyalinatus*, and (B) *H. punctatus*; mesopleuron of male (C) *H. hyalinatus*, and (D) *H. punctatus*.

female of *Halictus discus* was described from "North America" this is believed to be an error (Mitchell 1960; Ebmer 1976).

MEGACHILIDAE

***Anthidium oblongatum* (Illiger)**. A series of *Anthidium oblongatum* was collected in Toronto at York University campus in 2011 [col. C.S. Sheffield]. Most bees visiting *Lotus corniculatus* L. on campus are this species and the non-native *Megachile rotundata*, suggesting it is well established in Ontario. This species, native to Europe and the Near East, has been in Ontario since at least 2002 when three individuals were recorded by Romankova (2003). *Anthidium oblongatum* is well established in the eastern United States (Miller et al. 2002; Tonietto and Ascher 2008; Maier 2009) since it was first discovered in New York in 1994 (Hoebeke and Wheeler 1999). Miller et al. (2002) provide a key that can be used to recognize the species in eastern Canada. It is a cavity nesting species.

***Anthidium manicatum* (Linnaeus)**. This species, native to Europe, North Africa, and the Near East (Banaszak and Romasenko 1998) was first discovered in North America in the

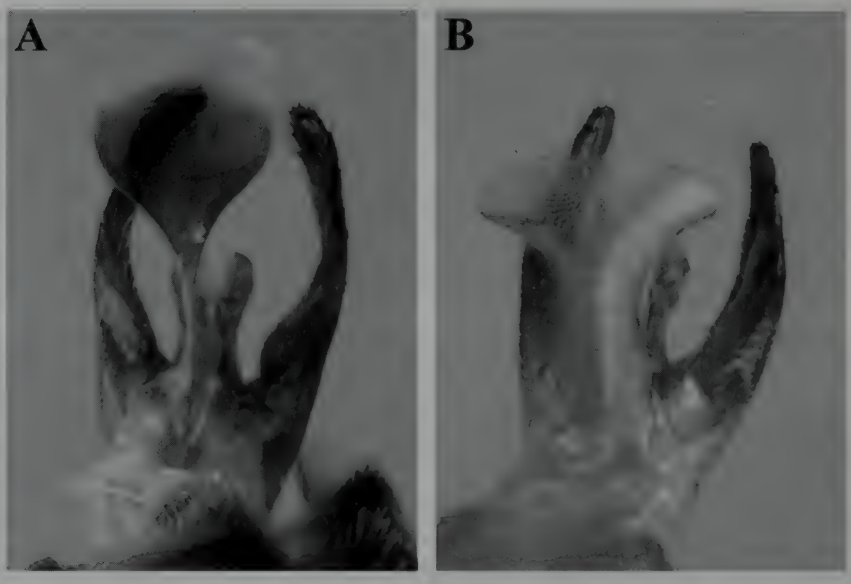

FIGURE 5. Distinguishing terminalia characters of males *Hylaeus* (*Spatulariella*) in North America. (A) *H. hyalinatus* S8, stalk narrow and apex rounded, (B) *H. punctatus* S8, stalk broad and apex emarginated or bilobed.

1960s (Jaycox 1967) and first reported in Canada (Ontario) in 1991 (Smith 1991). *Anthidium manicatum* is now well established and rapidly expanding its distribution throughout North America (Gibbs and Sheffield 2009; Maier 2009) and in 2011 was found on the island of Newfoundland (Barry Hicks, pers. comm.), within the likely range of establishment predicted by Strange et al. (2011). It is considered polylectic (Banaszak and Romasenko 1998) though commonly found associated with large urban and suburban gardens, particularly those with *Stachys* (Lamiaceae). It nests in cavities.

***Chelostoma campanularum* (Kirby).** Although only recently recorded in Canada, this cavity-nesting species has been here since at least 1976 (Buck et al. 2006), and is relatively common in Ontario in the cities of Guelph, St. Catharines, and Toronto. It occurs naturally in Europe and the Near East, and was first detected in North America in New York in the early 1970s (Eickwort 1980). The species is oligolectic on *Campanula* (Campanulaceae).

***Chelostoma rapunculi* (Lepeletier).** Like the preceding species, *C. rapunculi* is a cavity-nesting species introduced from the Palearctic region. It was first recorded in North America by Eickwort (1980), who examined specimens collected in New York from the early as 1960s. Females are also oligolectic on *Campanula*, though Buck et al. (2006) collected specimens on *Echium vulgare* L. (Boraginaceae).

***Hoplitis anthocopoides* (Schenck)**. Like the preceding two species, *H. anthocopoides* is from Europe and was first detected in North American in Albany County, New York, in 1969 (Eickwort 1970), though not collected in Canada until 2002 (Buck et al. 2006). As a reported floral specialist, its spread in North America may be linked to localized availability and population connectivity of its food plant, *Echium vulgare*. Eickwort (1975) gave detailed accounts of its biology. This species, unlike most of the other non-native megachilid bees presented here, is a true mason bee, building its nests from "mortar and pebbles". Because the nests are constructed on exposed areas of rocks, its mode of introduction into North America would presumably have been on exposed surfaces, not hidden in pre-existing cavities in wood, etc.

***Osmia caerulescens* (Linnaeus)**. This is probably our first established cavity-nesting bee species, arriving in North America in the 1800s. It occurs naturally throughout Europe, North Africa, the Near East and India (Rust 1974). In North America, this species is found primarily in northeastern and north central US and southeastern Canada to Nova Scotia (Rust 1974; Sheffield et al. 2003; 2008), though specimens have also been collected in British Columbia (specimens in PCYU) and in the north western United States (Cane 2003).

***Megachile* (*Eutricharaea*) *apicalis* Spinola**. This species is of Eurasian origin and was first reported as established in western North America by Cooper (1984). *Megachile apicalis* was only recently reported in Canada, collected in British Columbia in 2009 by Lincoln R. Best (Sheffield et al. in press), though it has recently been found in the eastern United States (S. Droege, pers. comm).

***Megachile* (*Eutricharaea*) *rotundata* (Fabricius)**. This species, also of Eurasian origin, has been established in western Canada for at least 50–60 years, and has been developed extensively as a commercial pollinator of alfalfa (Pitts-Singer and Cane 2011). *Megachile rotundata* has been found in eastern Canada since the 1990s as a result of deliberate introductions for lowbush blueberry (*Vaccinium angustifolium* Aiton) (Ericaceae) pollination. Sheffield (2008) and Sheffield et al. (2008) suggested that this species may have established in Nova Scotia prior to this, possibly due to pollination trials of forage crops in the 1970s and 1980s.

***Megachile* (*Callomegachile*) *sculpturalis* Smith**. This species, from eastern Asia, was first detected in North America in North Carolina in 1994 (Magnum and Brooks 1997). *Megachile sculpturalis* was first observed in Canada (Ontario) in 2002 (Magnum and Sumner 2003; Paiero and Buck 2004), and was recently collected in Quebec (Gibbs and Sheffield 2009). This species has great potential to spread throughout the continent (Hinojosa-Díaz et al. 2005; Maier 2009).

***Megachile (Pseudomegachile) ericetorum* Lepeletier**. This species is wide-ranging in the Western Palaearctic region, and has been in Canada at least since 2003 (Sheffield et al. 2010). It is currently known in North America only from a single female specimen collected on the Niagara Escarpment in St. Catharines, Ontario (Sheffield et al. 2010).

Apis mellifera **L.** This is the first bee species introduced into the Western Hemisphere, and the only bee species introduced intentionally into Canada. European settlers brought honey bees with them in the 1620s (Crane 1999; Horn 2005) for honey and wax production. These roles are now overshadowed in importance by crop pollination by *A. mellifera* throughout the world (Free 1993). It occurs from coast to coast in Canada, in all provinces and territories. Feral colonies are present throughout North America (including southern Canada), though numbers and persistence have declined since the arrival of parasitic mites in the last few decades (Droege 2008).

Conclusions

Major commodity entry points into Canada serve as likely entrance points for exotic species (Majka and LeSage 2006), including bees (Cane 2003; Sheffield et al. 2010). Ontario is one of the main entrance points for access so it is not surprising that all but one of the 17 exotic bee species in Canada are found in the province (Figure 6), and most of the

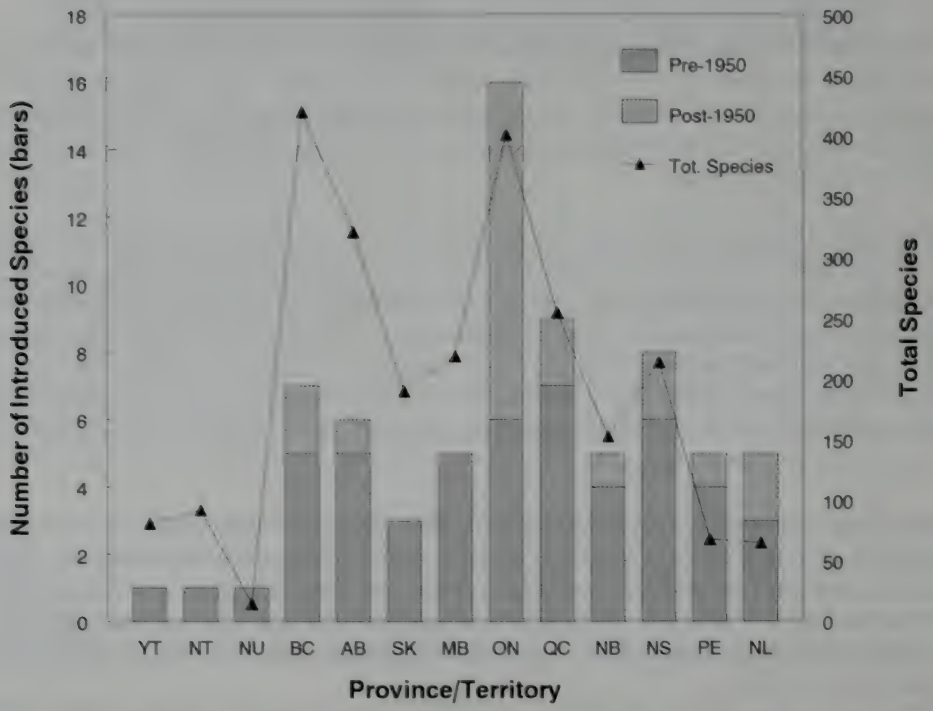

FIGURE 6. The number of introduced bee species occurring in each province or territory in Canada. Line with triangles represents total number of bee species known from each province or territory. Solid bars indicate species introduced to Canada pre-1950; cross-hatched bars represent post-1950 introductions.

post-1950s detections were first reported here (Smith 1991; Paiero and Buck 2004; Buck et al. 2006; Sheffield et al. 2010). An additional species, *Megachile xylocopoides* Smith, obtained from wood containing its mature larvae was recently intercepted at the Canadian border in Ontario (Hume Douglas, CFIA Ottawa, pers. comm.). Its identity was confirmed by DNA barcoding of larval tissue, and subsequent rearing. It is not established in Canada. As twelve of the 17 exotic bee species in Canada are cavity nesters, and specimens are sporadically intercepted at the Canadian border and at international entry points in the United States (Cane 2003), the likelihood of new arrivals is quite high. It is certainly worthwhile monitoring areas adjacent to the United States border because several additional non-native species are established in New York and adjacent areas of north eastern North America (Droege 2008; pers. comm.) and are likely spreading northward. Southern Ontario is likely to continue being the first region of arrival and detection of non-native bee species in Canada.

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FIRST RECORDS OF THE INVASIVE PEST, *HALYOMORPHA HALYS* (HEMIPTERA: PENTATOMIDAE), IN ONTARIO AND QUEBEC

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Scientific Note *J. ent. Soc. Ont.* 142: 45–48

Halyomorpha halys (Stål, 1855) (Hemiptera: Pentatomidae), the Brown Marmorated Stink Bug (BMSB) also known as the East Asian Stink Bug, is an agricultural pest native to China, Japan, Korea, and Taiwan that was first collected in North America in 1996 at Allentown, Pennsylvania, though the first published report was in 2001 (Hamilton 2003; Hoebeke and Carter 2003; Smith and Whitman 2007). BMSB is now almost ubiquitous in the USA where its pest status has dramatically increased – a considerable change in its status since it was first reported as an over-wintering nuisance (Smith and Whitman 2007). For Canada, the first official report of BMSB was from Balzac, AB (Bercha 2008). In late fall and early winter, 2010, we received two specimens for identification. The senior author identified both as *Halyomorpha halys*. Here we report these and other specimens intercepted in late 2010 as the first occurrences of BMSB in Ontario and Quebec. All the specimens are deposited in the Canadian National Collection of Insects, Arachnids and Nematodes (CNC), the Canadian Food Inspection Agency collection (CFIA) in Ottawa and the Department of Entomology, Guelph University (DEBU).

CANADA. British Columbia: Burnaby, 18.xi.2010, originating in Virginia on *Populus* lumber (4 adults, CFIA #10-07116); Vancouver, intercepted xi.2008 from China, Tianjin, Xingang via Busan, Korea (1 adult, CNC). **Ontario**: Hamilton, xii 2010, D. Wells, collected on a living room curtain in a private residence (1 adult, CNC); 6.x.2010, collected indoors (1 adult, CFIA #11-392); 10.vi.2011, inside private residence, homeowner reported seeing insects previously indoors and on garden tomatoes (1 adult, CFIA); 29.ix. private residence, specimen observed flying into home via ninth floor balconey (1 adult, DEBU); 18.xi, private residence, several adults in window AC unit (DEBU). Ottawa, collected 5.x.2011 from a car arriving from at a private residence in Virginia: Rappahannock Co., Washington, J. and C. Brown, (2 adults, CNC) and intercepted 15.x.2010 in spa sheets originating from New Jersey (6 adults, CFIA #10-06657). **Quebec**: Montreal x.2010, collected near a skid from USA (1 adult, CNC).

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The method of arrival into Canada of the Hamilton specimens is unknown. They may have migrated on their own from the USA or may have been accidentally transported in vehicles. The remaining specimens show how far and how easily BMSB may be passively transported by human activity to or within North America.

Adults of BMSB are about 14–17 mm long and 8 mm wide and generally brown with darker longitudinal streaks on the pronotum. Dorsally, the head, pronotum, scutellum, and hemi-elytra are densely covered with small brown pits on a whitish background (Figure 1). When the fore wings are spread each hemi-elytron is seen to have a distinct reddish tinge. The lateral margins of the abdomen have alternating whitish and black areas, iridescent green in certain lights. Ventrally, the body is paler in colour, with sparser brown pits distributed mostly laterally, and with transverse brown areas on each abdominal segment (Figure 1). Each tibia has a poorly defined white median band. The colour pattern on the two apical antennal segments is diagnostic for BMSB (Hoebecke and Carter 2003; Welty et al. 2008; Jones and Lambdin 2009)—the penultimate antennal segment is white basally and apically, and the apical segment is white basally so that the apical white band of the penultimate segment and basal band of the apical segment appear as a single band.

Nymphs and adults of BMSB feed on a wide range of crops including vegetables, fruit trees, woody ornamentals and some forest trees (Hoebeke and Carter 2003; Nielsen and Hamilton 2009). Adults generally feed on fruits whereas nymphs feed on leaves, stems and fruits. The pale green, barrel-shaped eggs are usually found in clusters of 20–30 (Hamilton 2003; Welty et al. 2008; Jacobs 2011) and hatch after about one week. The nymphs are small, oval-shaped, yellowish brown and mottled with white. Nymphs pass through five stages of one week each. Leaf damage is characterized by small lesions of about 3 mm in diameter which may then become necrotic and coalesce. Fruit damage is often in the form of small grooves, brown discoloration and necroses. Secondary damage may occur when other invertebrates or micro-organisms take advantage of the lesions and aggravate the BMSB damage.

Adult BMSB are strong fliers and highly mobile, and consequently are capable of spreading rapidly on their own. They are found in homes during their search for over-wintering sites but are harmless to humans and pets. They can become a nuisance when large numbers invade homes or land on building walls; penetration into homes is usually via structural openings and mostly around doors and windows. Sealing all cracks and crevices in outside walls of the home will help reduce entry (Day et al. 2011). Changing exterior lighting to yellow bulbs or sodium vapor will reduce their attractiveness to buildings. Control in agricultural crops remains a challenge. Although some active ingredients that control other stink bugs may also work against BMSB, research is needed to screen insecticides for effectiveness. In North America no natural enemies have yet been reported. In Asia, BMSB populations are kept in check by *Trissolcus* sp. (Hymenoptera: Scelionidae) (Arakawa and Namura 2002), which parasitize the eggs. Yang et al. (2009) described a new species from China, *T. halyomorphae* Yang, with parasitism rates of up to 70% on eggs of BMSB.

A comprehensive survey for BMSB in agricultural areas is needed because of the potential threat of BMSB as a serious invasive pest in Canada.

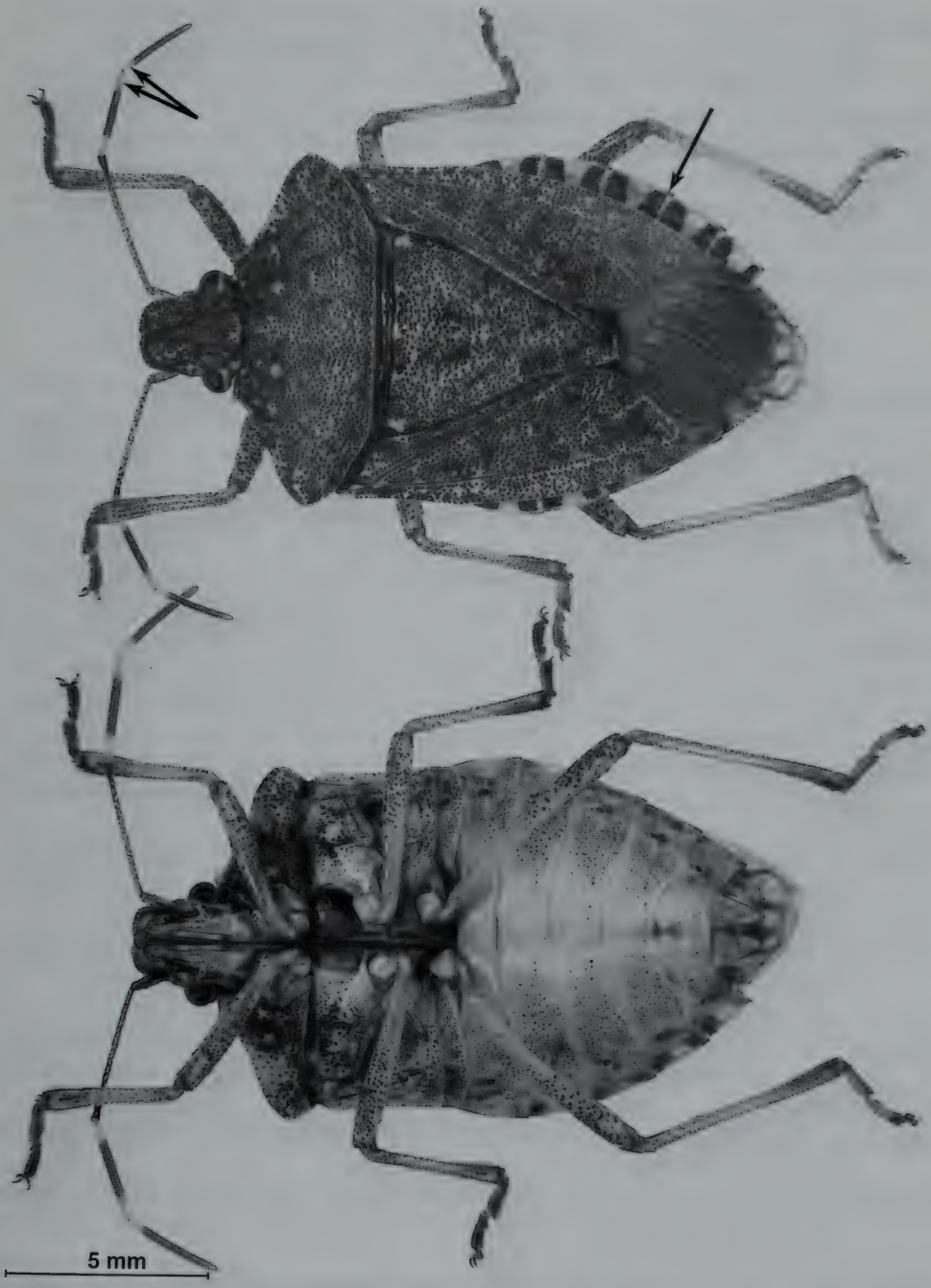

FIGURE 1. Brown Marmorated Stink Bug, *Halyomorpha halys* (Stål)(Pentatomidae), dorsal and ventral views. Arrows indicate diagnostic features.

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OCCURRENCE OF THE WOODLOUSE, *HYLONISCUS RIPARIUS* (KOCH) (ISOPODA: TRICHONISCIDAE), IN ONTARIO

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Most species of woodlice recorded in Canada are not native (Bousfield 1978), having been widely introduced from Europe. They play an active, although not exclusive, role as detritivores, especially in synanthropic habitats; however, in spite of their significant ecological role, they have received scant attention in Canada. Early reports that summarize data on the occurrence of woodlice in Ontario include Johansen (1926) and Walker (1927, 1928). Judd (1965) and Rafi and Thurston (1982) report on the woodlice of the London and Ottawa regions, respectively. Jass and Klausmeier (2000, 2001) present a compendium of woodlice species covering North American reports by state and province and list 13 species of woodlice as recorded from Ontario as follows: *Androniscus dentiger* Verhoeff, *Armadillidium nasutum* Budde-Lund, *Armadillidium vulgare* (Latreille), *Cylisticus convexus* (De Greer), *Haplophthalmus danicus* Budde-Lund, *Ligidium elrodii*, *Oniscus asellus* Linnaeus, *Porcellio laevis* Latreille, *Porcellio* scaber Latreille, *Porcellio spinicornis* Say, *Porcellionides pruinosus* (Brandt), *Trachelipus rathkii* (Brandt), and *Trichoniscus pusillus* Brandt. Additionally, Rafi and Thurston (1982) report *Philoscia muscorum* (Scopoli) from the Ottawa region and Dexter et al. (1988) collected *Hyloniscus riparius* (Koch) on Middle Island in western Lake Erie (the southernmost point of land in Canada), meters from the Ontario-Ohio border. Here we record the first mainland Ontario occurrence for *Hyloniscus riparius* (Koch) and propose that this small woodlouse is more widespread in Ontario than these two collection records suggest.

During investigations of the woodlice of southern Ontario and the Maritimes, one of us (MJO) collected 3 females of *Hyloniscus riparius* (Figure 1A) from the Braeside Alvar (alvar = limestone plain characterized by thin soils and sparse vegetation), 3 km northwest of Braeside, Renfrew County, Ontario (45.482°N 76.442°W) on 23 June 2010. Voucher specimens were deposited in the general invertebrate collections of the New Brunswick Museum (NBM 10221). Our specimens agree with the description and illustrations provided

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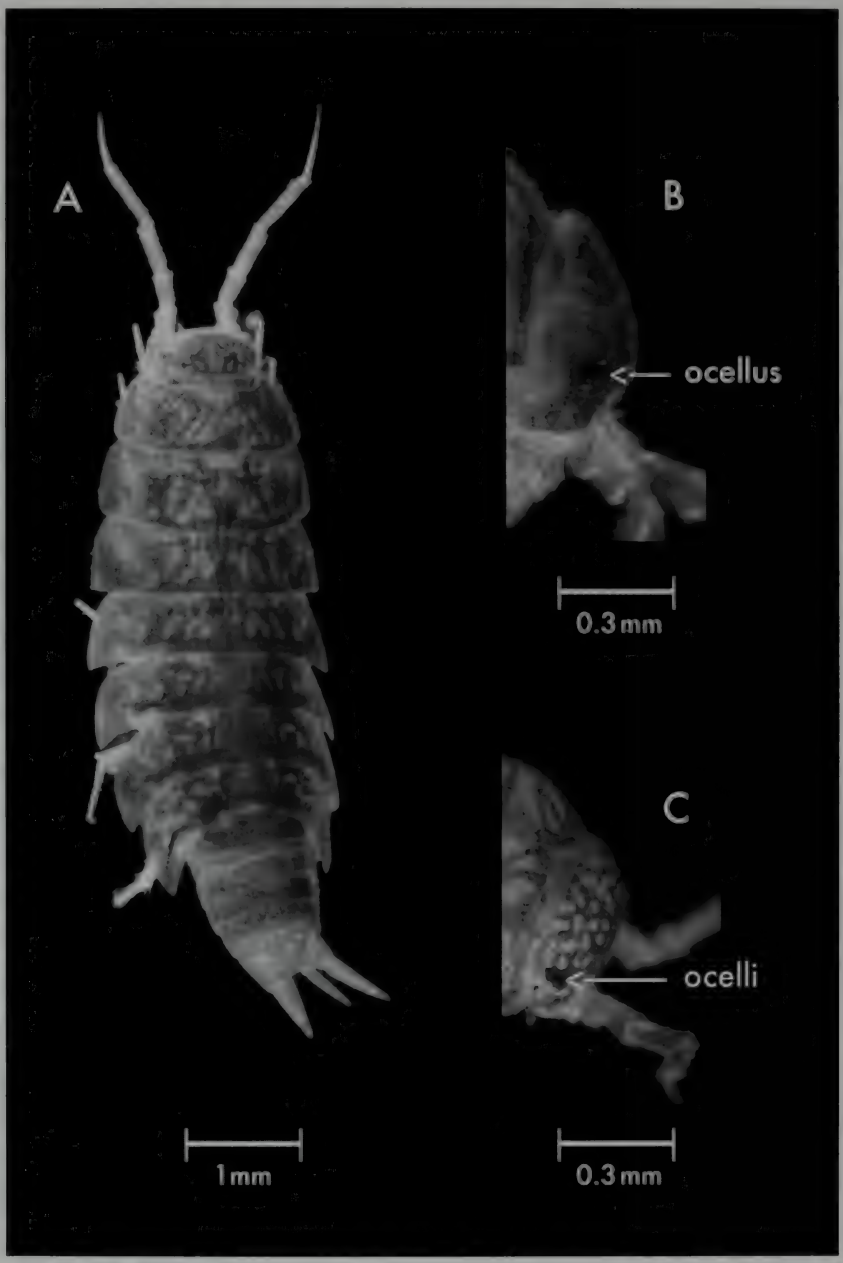

FIGURE 1. Comparison of Ontario specimens of *Hyloniscus riparius* and *Trichoniscus pusillus*: A) *Hyloniscus riparius*, entire body (NBM 10221; Braeside, Ontario); B) *H. riparius*, head—note the single ocellus; C) *Trichoniscus pusillus* (NBM 10223; Bishops Mills, Ontario)—note the three ocelli comprising each eye.

by Schultz (1965); the 6 flagellar segments are visible (characteristic of Trichoniscidae) and the single left and right ocellus (Figure 1B) immediately distinguish *H. riparius* from the superficially similar and more common *T. pusillus*. In the latter species, 3 ocelli make up each eye (Figure 1C). The Braeside specimens range in size from 4.6–6.3 mm (head–telson), approximating the range for females (2.6–5.2 mm) reported by Schultz (1965). One of the females was gravid with 8 eggs. Schultz (1965) found the sex ratio strongly female biased (2:1) in New Jersey and reports the number of offspring in marsupia ranging from 5–17, with a mean of 10. Likewise, Jass and Klausmeier (2003) found females predominant in Wisconsin, but did find a significantly higher proportion of males (34.7%) from localities in the north of the state.

The specimens we collected appear to be the first mainland occurrence for this eastern and central European woodlouse in Ontario, and only the third for Canada (Dexter et al. 1988; Jass and Klausmeier 2001). The first was that of Palmén (1951) for St. John's, Newfoundland (the latter, coincidentally, the first for North America). Palmén (1951) found *H. riparius* closely associated with a greenhouse and garden in St. John's and felt the species occurrence in Newfoundland to be entirely dependent on such habitats. However, Muchmore (1957) and Schultz (1965) provided evidence of well-established, permanent, outdoor populations of *H. riparius* in New York, New Jersey, North Carolina, and Pennsylvania, and Jass and Klausmeier (2000) also included Michigan and Wisconsin. Jass and Klausmeier (2003) studied the reproductive biology of *H. riparius* in Wisconsin and found that the in-soil habits of the species, relative to the more surface-active *T. rathkii*, permitted the former to extend its breeding season. As a less surface-active species, *H. riparius* would seem well adapted to surviving outside the greenhouse habitat over much of Ontario.

Jass and Klausmeier (2000) report habitat preferences for *H. riparius* as "wetlands, riparian". Muchmore (1957) found numerous specimens under logs, rocks and debris. According to Schultz (1965), *H. riparius* in North America is often associated with stream-side habitats or damp areas with dense weed cover. Dexter et al. (1988) report *H. riparius* to be a shoreline species on the six islands in western Lake Erie where it was collected. Jass and Klausmeier (2003) found this species in a wide variety of habitats in Wisconsin, including sites dominated by native vegetation, but all characterized by high soil moisture. The specimens reported here were collected from beneath logs and debris in association with *T. rathkii* (NBM 10222) from a site characterized as disturbed alvar.

It seems likely that *Hyloniscus riparius*, well established outside the greenhouse habitat in North America for at least half a century and with Canadian occurrences now known from Newfoundland and both mainland and insular Ontario, is much more widely distributed in eastern Canada than the current few records indicate.

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DISCOVERY OF *BOMBUS DISTINGUENDUS* (HYMENOPTERA: APIDAE) IN CONTINENTAL NORTH AMERICA[1]

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The bumblebees of North America have received much attention, not only because these charismatic bees are important for pollination of native plants, but also because several bumblebee species have recently declined rapidly (Colla and Packer 2008; Grixti et al. 2009; Williams and Osborne 2009; Cameron et al. 2011). As a result, the North American fauna is one of the best known (Williams 1998). However, even for such a well-studied group, the taxonomic status of several species in North America remains unclear because of unique and geographically separate colour forms with very few specimens (e.g., *B. cockerelli* Franklin), close affinities with Old World species complexes (e.g., *B. moderatus* Cresson; Scholl et al. 1990), and variable intra- and interspecific colour patterns (e.g., Stephen 1957; Williams 2007; Owen et al. 2010). These difficult cases have prompted the application of molecular methods (e.g., DNA barcoding) to supplement traditional morphology-based taxonomic study (Murray et al. 2008; Bertsch et al. 2010; Owen et al. 2010; Williams et al. 2011).

Williams and Thomas (2005) recorded *B. distinguendus* Morawitz for the first time in the New World from Attu Island, at the far western end of the Aleutian archipelago. This discovery made *B. distinguendus* one of perhaps eight bumblebee species with a Holarctic distribution, though restricted to the western edge of North America. As part of an ongoing campaign to obtain COI sequences for the bees of the world, bumblebees from across the continent have been collected and/or donated by collaborators in Canada and the United States. In one series of specimens from Alaska, three females (two from Fairbanks, 64.747°N 148.086°W, 28.vii.2009 and 64.86°N 147.86°W, 11.vi.2009; one from Palmer, 61.567°N, 149.233°W, 18.v.2009), deposited in the Department of Biology, York University, Toronto, Canada, and The Natural History Museum, London, UK, were identified initially (by CSS) as *B. appositus* Cresson based on external morphology. These were then DNA barcoded (see Sheffield et al. 2009 for procedures) because Alaska would represent a northern range extension for this species (Stephen 1957; Milliron 1973), and sequences and images were loaded to the BOLD (Barcodes of Life Data System; http://www.boldsystems.org) library.

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Surprisingly, the sequences were unique among North American *Bombus* species, showing 1.55% divergence from the nearest neighbour, *B. appositus*, and matching those of *B. distinguendus* from Attu Island. An additional specimen, labelled "90106/Airport Willow Bar/ Fbnks Intl Airport/On Hedysarum boreale/25 May 90/J.A. Bishop", deposited in the University of Alaska Museum, Fairbanks, Alaska, and identified as *B. appositus*, was also examined. Identification of these specimens was later verified (by PHW) as *B. distinguendus*. Williams and Thomas (2005) and Williams et al. (2011) provided keys to separate the species; the latter give additional illustrations and diagnoses to separate the species. Further information on the specimens studied here, including COI sequence information (accession numbers, etc.), can be found in Williams et al. (2011).

In light of the discovery (Williams and Thomas 2005) and subsequent DNA barcoding of *B. distinguendus* from Attu Island, and with the DNA barcode-assisted discovery on continental North America reported here, the utility of DNA barcoding for detecting bees with previously unrecorded Holarctic distributions seems promising. However, the relationship among North American *B.* (*Subterraneobombus* Vogt) and the presence of *B. distinguendus* in continental North America is somewhat puzzling on the basis of COI results. Hines (2008) reported that vicariance events between the Old and New Worlds across Beringia involved splits among boreal species, including *B. appositus* and *B. borealis* from *B. distinguendus*. Supporting this, levels of COI divergence between North American *B. distinguendus* and the other *B.* (*Subterraneobombus*) are very low; 1.55% between *B. distinguendus* and *B. appositus*, and 1.86% between *B. distinguendus* and *B. borealis* Kirby, (Williams et al. 2011), probably attributable to the spread and recent (< 2 Myr) arrival of an ancestral *distinguendus* complex in the Nearctic (Williams 1985; Hines 2008).

Surprisingly, the Alaskan specimens (Attu Island and mainland) show greater COI sequence similarity to populations that are most geographically distant from them (Williams et al. 2011), namely, 0.3 ± 0.34% (max. 0.62%) sequence divergence between Alaska and UK, 0.93 ± 0.15% (max. 1.8%) between Alaska and Europe (excluding UK), and 1.1 ± 0.1% (max. 2.2%) between Alaska and the Russian Far East. These differences were reflected in the high level of divergence in this species across its range (2.67% maximum sequence divergence), which Williams et al. (2011) attribute to perhaps higher levels of habitat fragmentation and population isolation in the northern parts of its range during glacial cold periods.

Although some species of *Bombus* have been introduced to areas outside of their natural range, it seems unlikely that populations of *B. distinguendus* would have been deliberately introduced into southern Alaska, especially from the UK. Explanation of the similarity of COI between Alaska and UK populations is further confounded because the sequences conflict with the pattern of variation in pubescence colour. In this respect, the North American specimens actually resemble more closely the Old World populations that are geographically closer, in Russia (Williams et al. 2011), as would be expected (Hines 2008). Although it is tempting to suggest a possible thermoregulatory role for darker pubescence (Pekkarinen 1979), the principal global pattern is for darker forms in *Bombus* to be associated more with tropical climates (Williams 2007). However, the relationship between bumblebee colour pattern and thermoregulation is not well understood.

Although it seems clear that *B. distinguendus* was not introduced into North America by human activity, it is surprising that populations would have gone undetected for so long, as bumblebees have been one of the most intensively studied and heavily surveyed bee groups on this continent (Williams 1998). This species may simply be very rare in North America; it is presently only known from these three specimens reported above and the 17 specimens reported by Williams and Thomas (2005), and males have yet to be collected in North America. But it may also have been easily confused with *B. appositus* and *B. borealis*, less so with *B.* (*Thoracobombus*) *fervidus* (Fabricius), though only *B. appositus* and *B. borealis* have ranges that approach or include southern Alaska. Clearly, further studies incorporating traditional morphological and additional genetic (e.g., Schmid-Hempel et al. 2007; Lye et al. 2011) approaches for *Bombus* distribution and phylogeny are needed, and these may help resolve the puzzling COI sequence and colour form distributional patterns of *B. distinguendus*. The recent discovery of *B. distinguendus* highlights the need for more complete surveys of bees, especially in previously unsampled or poorly sampled areas, and for continued taxonomic study of these important pollinators.

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